

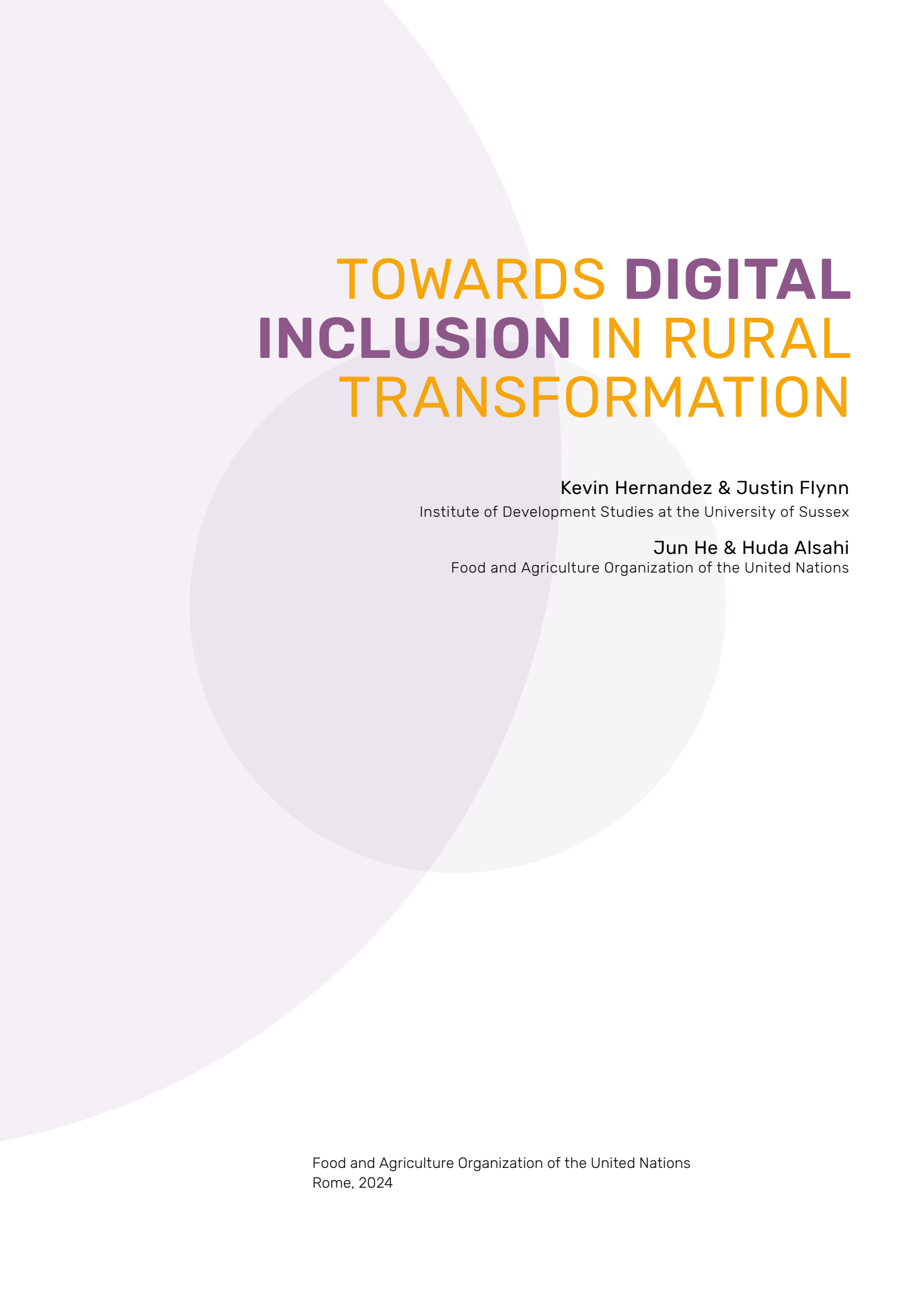


Food and Agriculture
Organization of the
United Nations



TOWARDS DIGITAL INCLUSION IN RURAL TRANSFORMATION





TOWARDS DIGITAL INCLUSION IN RURAL TRANSFORMATION

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Kazakhstan

Milk procurement managers using a smart photo mobile phone application developed by FAO.

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FOREWORD

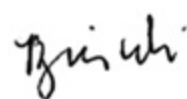
DIGITAL TECHNOLOGIES HOLD IMMENSE POTENTIAL to contribute to inclusive rural transformations and to accelerate progress for the Sustainable Development Goals (SDGs). Enhancing access to these technologies is crucial for advancing progress towards SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 10 (Reduced Inequalities). Yet, the rapid march of digitalization raises pertinent questions. Will these advancements genuinely promote inclusivity and benefit marginalized or vulnerable groups? Or will these advancements exacerbate the digital divide, further isolating the rural poor, women, young people, persons with disabilities, Indigenous Peoples, older persons, migrants, displaced people, and community/local organizations in rural areas and agrifood systems?

Rural populations were at risk of digital exclusion even before the COVID-19 pandemic which accelerated the trend of service digitalization, further diminishing offline alternatives and perpetuating existing digital divides. Digital agricultural applications, social media platforms for marketing, seamless access to government services, and remote learning are examples of sectors that are becoming increasingly digitalized but are less accessible to rural residents, marginalized groups, and underserved populations due to limited access to internet-enabled devices, internet connectivity and offline service centres. While digital inclusion is crucial for fostering inclusive digital transformations that enhance agrifood systems and sustainable rural livelihoods, digitalization alone does not ensure inclusion.

Nevertheless, the United Nations and its specialized agencies, international organizations, research institutions, and, more broadly, the private sector (especially those engaged in providing digital and information technology services) are making significant efforts to promote digital inclusion. As emphasized in the UN Secretary-General's Roadmap for Digital Cooperation and its accompanying documents, digital inclusion is defined as "equitable, meaningful, and safe access to use, lead and design of digital technologies, services, and associated opportunities for everyone, everywhere (UN, 2020)."

However, promoting digital inclusion and addressing digital exclusion requires a gradual and ongoing process, and a one-size-fits-all model is not universally feasible. International organizations, including FAO, must consistently prioritize inclusivity in the technology models they promote or the work they undertake. This involves broadening the understanding of digital inclusion and the digital divide, offering training and capacity development on digital inclusion, conducting analytical and normative work to identify and address potential exclusion, and customizing appropriate technologies and interfaces.

Only through such measures can we genuinely embrace the digital era and harness digital technologies to positively contribute to the 2030 Agenda, all while minimizing the exacerbation of inequalities and the deepening of the digital divide resulting from digitalization, which is essential to truly achieve the aspiration of leaving no one behind.



Benjamin Davis
ESP Director

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We hope this report will be a valuable reference for future research and practical projects aiming to utilize digital technology for rural transformation, improved digital inclusivity and more significant benefits to rural communities.

ABBREVIATIONS

A4AI	Alliance for Affordable Internet
ASAN	Azerbaijan Service and Assessment Network
AYA	African Youth Entrepreneurs
CBO	community-based organization
DVI	1000 Digital Villages Initiative
EBRD	European Bank for Reconstruction and Development
EGDI	United Nations' E-Government Development Index
FAO	Food and Agriculture Organization of the United Nations
GB	gigabyte
Gbps	gigabits per second
GDP	gross domestic product
GSMA	Global System for Mobile Communications Association
HIC	high-income country
ICT	information and communications technology
ITU	International Telecommunication Union
LAC	Latin America and the Caribbean
LDC	least developed country
LIC	low-income country
LLDC	landlocked developing country
LMIC	lowermiddle-income country
LOSI	Local Online Services Index
HIC	high-income country
MIC	middle-income country
PC	personal computer
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
SSA	sub-Saharan Africa
UNDESA	United Nations Department of Economic and Social Affairs
UNESCO	United Nations Educational, Scientific and Cultural Organization
USB	Universal Serial Bus
USFs	Universal Service Funds



Collaboration among
various stakeholders
is key to achieving
inclusive digitalization
and advancing rural
transformation.

EXECUTIVE SUMMARY

THE RAPID AND ONGOING DIGITAL TRANSFORMATION of government, economic, and social sectors holds immense potential to improve outcomes across the SDGs for smallholder farmers and rural communities more generally. However, it is also widely recognized that digitalization alone does not guarantee inclusion. Rural residents and marginalized groups have the most to gain from digitalization but are also the most at risk of falling further behind due to digital divides. The resulting paradox may leave rural development actors unsure about how to best approach rural digital transformation. This report helps rural development practitioners and decision-makers work through this paradox. It does so by highlighting the factors that lead to digital exclusion, providing evidence regarding how digital divides play out, and providing recommendations on how to improve digital inclusion for rural areas and marginalized groups.

The first step in working through this paradox is to illustrate the circumstances under which poorly managed digitalization can lead to digital exclusion. The report highlights three factors that when combined lead to digital exclusion: (i) the digitalization of agrifood systems and other sectors vital to the well-being of farmers, (ii) the absence or removal of offline alternatives, and (iii) the persistence of digital divides.

SECTION ONE DIGITALIZATION ACROSS SECTORS IN RURAL AREAS

provides a brief overview of the ongoing digitalization in various sectors (digital agriculture, government services, social protection, humanitarian aid, and education), emphasizing the omnipresent threat of digital exclusion for rural populations. It is important to note that this section serves as a starting point for discussion rather than as an exhaustive summary of the current state of digitalization in each sector. Additionally, it does not encompass all sectors undergoing digitalization in rural areas. The intention is to highlight that while the digitalization of agrifood systems is of particular interest in combating poverty, hunger and inequality, focusing solely on this aspect may hinder the efforts, as smallholders are influenced by digitalization in sectors beyond agrifood systems.

SECTION TWO THREE LEVELS OF URBAN-RURAL DIGITAL DIVIDE

delves deeper into the digital divide. It uses the three levels of the digital-divide framework to illustrate how these dynamics disadvantage rural areas in lower middle-income countries (LMICs), especially women and marginalized groups. These groups disproportionately face multiple dimensions of the digital divide, including: (i) limited access to digital technology and increased likelihood to experience barriers to access (known as first-level digital divides), (ii) lower quality of access and the existence of after-access barriers such as lack of digital skills (known as second-level digital divides), and (iii) structural inequalities that hinder their ability to benefit from digital technology use (known as third-level digital divides). These digital divides threaten to exacerbate inequalities if the trends uncovered in Section 1 (rapid digitalization and absence of offline alternatives) continue.

Some key digital-divide findings uncovered in Section 2 include:

First-level digital divide

- Rural residents are about half as likely to have basic access to the internet (measured as having used it once in the last three months) globally, with the gap being significantly higher in least developed countries (LDCs) (73 percent) and in Africa (70 percent)¹
- There are persistent divides in mobile phone ownership between rural and urban areas and between women and men.
- The gender gap in device ownership and the gender gap in use of specific digital technologies (e.g. mobile money) tends to be wider in rural areas than it is in urban areas. This is especially true for low-income countries (LICs) and LIMICs.
- Although most of the world is covered by a mobile signal (at least a 2G signal), rural areas, especially those in LDCs and Small Island Developing States (SIDS) are less likely to be covered. These divides are progressively worse for newer connectivity technologies (e.g. 3G, 4G and 5G).
- People living in rural areas (especially rural women) are more likely to experience barriers to gaining access to the internet:
 - Rural areas account for a disproportionate concentration of the world's poor making affordability a bigger hurdle for rural communities.

¹ ITU. 2021. Statistics. In: ITU. Geneva, Switzerland. [Cited 28 March 2024]. <https://tinyurl.com/48kcy5p3>

- A lack of electricity often makes it more difficult for rural residents to charge portable devices or to use Wi-Fi or personal computers (PCs).
- Evidence shows that registering a sim card is the most reported entitlement that people lacking identification struggle to access. This requirement disproportionately affects rural residents, youth, and women who have all been shown to disproportionately lack identification.²

Second-level digital divide

- When rural residents and women from LICs and LMICs have access to devices and the internet, they often use it less and for less activities than urban residents and men.
- Girls and young women are more likely to only have access through borrowing devices which may lead to them engaging in less online activities than boys and young men.³
- Data indicates that people living in rural areas who are able to engage in digital activities engage in them less frequently than urban residents.⁴
- 18 percent of rural residents in sub-Saharan Africa reported using mobile phones and the internet at least a few times a week compared with 48 percent of urban residents in 2018.⁵
- Although basic gaps in access to the internet (measured as using the internet once in the last three months) are decreasing, gaps in internet speeds between high-income countries (HICs) and LMICs, and urban and rural areas are more pronounced.
- Rural areas in LMICs face a notable absence of high-speed fibre-optic fixed-broadband, leaving them reliant on slower 2G and 3G mobile broadband.
- Users that cannot afford to stay connected continuously or who lack sufficient data often resort to rationing their data and only using their devices for the most essential activities. Data shows this practice is common across 11 LMICs analysed.⁶
- Users from rural areas may be more likely to experience periodic (daily or weekly) disruptions to their internet service creating experiences of intermittent access as they move around rural areas with spotty coverage.
- Due to lower levels of educational attainment, rural residents and women are less likely to have the digital skills necessary to make effective use of digital technology.
- There are gaps in the types of devices used between better-off and marginalized groups. Some users rely on outdated low-quality devices with lower levels of security. For example, 3G connectivity was projected to peak in Africa in 2023 largely due to the lack of affordable 4G enabled phones in local markets.⁷
- Having access to both a smartphone and a PC provides users with the most meaningful experience allowing them to take advantage of the possibilities offered by both sets of devices. However, rural residents are significantly less likely to have access to both or any of these devices.⁵
- When combining multiple second-level digital divide dimensions (e.g. access to a smartphone or PC, 4G speeds, everyday use and unlimited data), digital divides between urban areas and rural areas, and between men and women are shown to be significantly steeper than gaps in basic access to the internet.⁸

Third-level digital divide

- Rural residents are more likely to live in extreme poverty and are thus less likely to leverage economic resources online.
- Rural residents and women tend to have lower levels of educational attainment which limits their ability to leverage digital technology to further increase their human capital and employment prospects.
- Rural residents often have smaller social networks or less access to powerful and influential people which limits the social relationships they can leverage online.
- Social norms are often more intractable in rural areas and shape who is allowed to use technologies and for what purposes. This can further exacerbate outcomes by those deemed

² Clark, J., Metz, A. & Casher, C. 2021. *ID4D Global Dataset 2021, Volume 1: Global ID coverage estimates*. Washington, DC, World Bank.

³ Girl Effect. 2018. *Real girls, real lives, connected: A global study of access and usage of mobile, told through 3000 voices*. New York, USA, Girl Effect, and London, Vodafone Foundation.

⁴ GSMA. 2021. *Access to mobile services and proof of identity 2021: Revisiting SIM registration and know your customer (KYC) contexts during COVID-19*. London.

⁵ Kronke, M. 2020. *Africa's digital divide and the promise of e-learning*. Afrobarometer Policy Paper No. 66. Accra, Afrobarometer.

⁶ Silver, L., Vogels, E.A., Mordecai, M., Cha, J., Rasmussen, R. & Rainie, L. 2019. Mobile divides in emerging economies. In: *Pew Research Center*. Washington, DC. [Cited 28 March 2024]. <https://tinyurl.com/bdf7ajez>

⁷ GSMA. 2021. *The mobile economy: Sub-Saharan Africa 2021*. London.

⁸ Alliance for Affordable Internet. 2022b. *Meaningful connectivity for rural communities: Geographic barriers & policy strategies for digital inclusion*. Washington, DC.

worthy and unworthy of using technology or specific digital solutions.

- Better-off social and political movements have higher levels of digital access and a higher capacity to make use of technologies to further their causes than poorer and worse off groups.
- Local markets are more likely to be dysfunctional in rural areas. This limits the uptake success of digital agriculture apps and other SDGs related digital solutions in rural areas unless these failures are addressed.

SECTION THREE

WAYS FORWARD: BEST PRACTICES TO IMPROVE DIGITAL INCLUSION

presents several ways that rural development actors can improve digital inclusion. The section proposes that rural development actors take a series of measures to address digital exclusion across three areas. First, digitalization should be responsive to the needs and priorities of all individuals, especially the rural poor and marginalized groups. Second, providing offline options can ensure continued participation for those with limited technology access. Third, explicitly addressing digital divides and reducing structural inequalities are crucial to preventing further exclusion and disparities. These actions are summarized below.

Gender- and marginalized-group-responsive digitalization

- Promote people-centred design processes with an emphasis on putting the most marginalized and hardest to reach at the centre.
- Facilitate gender and marginalized group responsiveness and mainstreaming across all digitalization efforts.
- Make digital solutions and content accessible for users with disabilities and users with lower levels of language literacy.

Providing offline options

- Offline service delivery options should complement digital solutions, and a “digital by default” approach or “digital first” strategy should be avoided.
- Promote multichannel service delivery which blends digital, hybrid and offline options for citizens to engage with the state and service providers.
- Efforts may be needed to map and address situations in which offline options are absent or have been removed.

- The capacity of both formal and informal intermediaries should be strengthened through technical support and funding.

Addressing digital divides

- Provide and support the provision of digital-skills training in a way that is responsive to the needs of marginalized groups from rural areas.
- Provide technical assistance on gender mainstreaming to telecentres to help make them more inclusive of marginalized groups.
- Provide technical assistance on gender mainstreaming to Universal Service Funds to help ensure that their investments benefit all rural residents equally.

SECTION FOUR

CONCLUSIONS AND RECOMMENDATIONS

recommends rural development organizations adopt digital-inclusion narratives based on the three factors that improve digital inclusion identified in this study: (i) marginalized-group- and gender-responsive digitalization, (ii) ensuring offline alternatives, and (iii) tackling digital divides across all levels. This narrative can assist rural development organizations and practitioners in adapting organizational practices and implementing programmes that address digital exclusion and avoid exacerbating inequalities. Once an internal normative framework is in place, digital inclusion guidelines can be developed to help partner rural development organizations improve digital-inclusion. Such a tool can help rural development organizations and digital agriculture practitioners integrate inclusive practices into programme/project design and field operations. These narratives can also help rural development organizations broaden their understanding of digital inclusion and inform the design of surveys that consider after-access barriers with data sufficiently disaggregated by gender and marginalized groups, and between rural areas with differing characteristics. This will help identify who may be left behind, and to tailor appropriate digital solutions.

In conclusion, achieving an inclusive process of rural digital transformation requires collaboration among various stakeholders. In an increasingly digital world, it is more important than ever to tackle poverty and structural inequalities alongside addressing potential digital exclusions. FAO and partners must double down efforts to address disparities between urban and rural areas, between men and women, as well as between marginalized and better-off groups within rural areas.



Bangladesh

In Panjarbhangra, people use a computer tab as a learning device to improve the design and management of agricultural investments.

©FAO/Mohammad Rakibul Hasan

INTRODUCTION

IN 2021, ACCORDING TO THE INTERNATIONAL TELECOMMUNICATION UNION'S (ITU) internet usage survey (ITU, 2021a), approximately 63 percent of the global adult population was estimated to have used the internet at least once in the preceding three months. However, significant disparities in internet usage between rural and urban areas were observed. Urban residents had a much higher internet usage rate (76 percent) compared to rural residents (39 percent), and the majority (96 percent) of individuals who had not used the internet in the three months preceding the survey were from lower middle-income countries (LMICs). Gender disparities were also evident, with 57 percent of women and 62 percent of men having used the internet in the past three months at the global level, and these gaps were particularly pronounced in least-developed countries (LDCs).

Many studies cite these “internet user” figures to emphasize the risk of digital exclusion for individuals without access, but it is important to note that being classified as an “internet user” simply means having used the internet once in the last three months. It does not provide a comprehensive understanding of an individual's digital experience or their vulnerability to exclusion in the context of digital agriculture solutions or digitalization in general (A4AI, 2022; Hernandez and Faith, 2022).

This study aims to demonstrate that the uneven exposure to digital exclusion faced by rural residents in LMICs extends beyond the already high percentage of non-internet users (61 percent). It particularly affects individuals experiencing intersecting inequalities, including women in LDCs (81 percent), who are often overlooked. Additionally, even those who manage to access the internet in rural areas are likely to encounter after-access barriers that can contribute to digital exclusion during digitalization. The study, therefore, seeks to encourage global development and aid organizations and practitioners to move beyond binary conceptualizations of the digital divide and adopt a holistic approach to addressing digital exclusion within their programming and beyond.

Improving digital access is a crucial priority in the 2030 Agenda for Sustainable Development, as reflected in various SDGs, targets and indicators. These include:

TABLE 1

Goals, targets and indicators related to digital access in the SDGs framework



GOAL 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

TARGET 4.4

By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

INDICATOR 4.4.1

Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill.



GOAL 5 Achieve gender equality and empower all women and girls

TARGET 5.B

Enhance the use of enabling technology, particularly information and communications technology, to promote the empowerment of women.

INDICATOR 5.B.1

Proportion of individuals who own a mobile telephone, by sex.



GOAL 9 Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

TARGET 9.C

Significantly increase access to ICT and strive to provide universal and affordable access to the internet in least developed countries by 2020.

INDICATOR 9.C.1

Proportion of the population covered by a mobile network, by technology.



GOAL 17 Strengthen the means of implementation and revitalize the global partnership for sustainable development

TARGET 17.6

Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism.

INDICATOR 17.6.1

Fixed internet broadband subscriptions per 100 inhabitants, by speed.

TARGET 17.8

Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, particularly information and communications technology.

INDICATOR 17.8.1

Proportion of individuals using the internet.

Digital technologies have the potential to impact all 17 SDGs and the overarching goal of leaving no one behind (Hernandez and Roberts, 2018; ITU, 2017; Unwin, 2017). ITU (2017) demonstrates how digital technologies can be leveraged to achieve progress across all 17 SDGs. However, the ITU also warned that leveraging digital technology to make progress against SDG goals requires individuals to have access to digital technologies. As a result, there is a significant risk of exacerbating inequalities if digital divides persist (ITU, 2017). It is therefore important to acknowledge that digitalization and reliance on digital technologies for development gains can have both positive and negative effects. While digital technologies offer opportunities to reduce development costs, improve efficiency and promote inclusion, the digital divide poses a risk of leaving behind those who are already marginalized and vulnerable, particularly those facing intersecting deprivations (Hernandez and Roberts, 2018).

Furthermore, the relationship between digitalization and achieving the SDGs related to environmental sustainability, social justice, and equality is complex and not always positive (Hernandez, 2019; Unwin, 2017). Recently, the United Nations Secretary-General introduced a Roadmap for Digital Cooperation with a vision where “every person has safe and affordable access to the internet by 2030, including meaningful use of digitally-enabled services, in line with the sustainable goals” leading to the creation of a new UN framework on universal and meaningful digital connectivity (United Nations Office of the Secretary-General’s Envoy on Technology and ITU, 2021; United Nations Secretary-General, 2020a, p. 23).

Digital technologies have the potential to impact all 17 SDGs and the overarching goal of leaving no one behind.

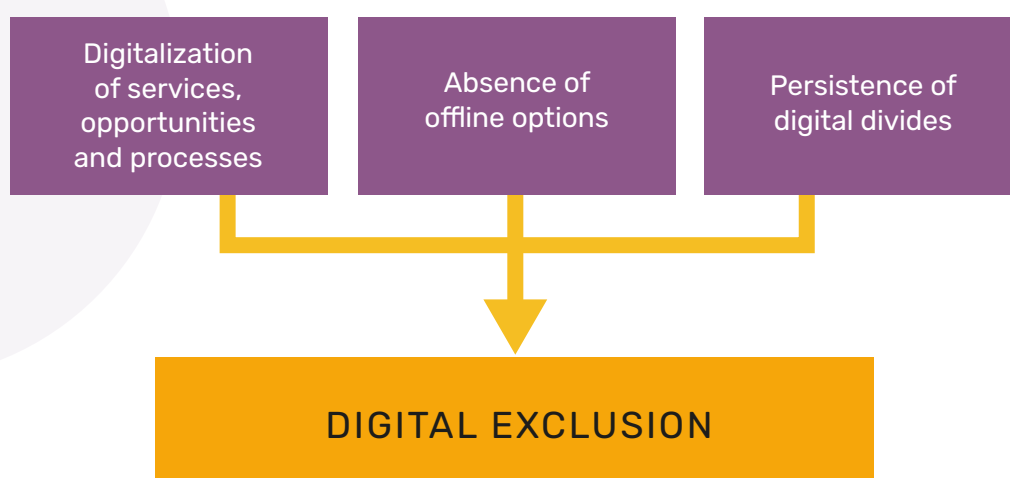
Rural communities in LMICs, women, young people, persons with disabilities, Indigenous Peoples, older persons, migrants, and displaced people are among the least likely to have online access and are more likely to experience digital exclusion. FAO recognizes that bridging the digital divide and promoting digital technology adoption among smallholder farmers and producers are crucial for facilitating inclusive digital transformations that improve agrifood systems and rural livelihoods, while ensuring no one is left behind. Reducing the digital divide is seen as a pathway to poverty reduction and equitable access to services, thereby accelerating progress towards achieving the SDGs. Therefore, it is essential to establish a clear understanding of what digital inclusion and the digital divide entail – as well as their implications – to achieve inclusive digital transformation in rural areas.

Digital inclusion refers to equitable, meaningful and safe access to – and use of – digital technologies, services and associated opportunities for everyone, everywhere (UN, 2020). The sufficiency of access, skills and quality of digital technologies can vary across contexts, over time and among different groups within a given context. Digitalization alone does not cause digital exclusion. It is the combination of digitalization done in a manner that is not responsive to the needs of marginalized groups, the absence of

offline alternatives, and the persistence of digital divides that results in exclusion (see Figure 1 below). Given the emphasis on “full participation” in society, digital exclusion occurs when these three factors restrict participation in any sector related to well-being. However, these factors can also be analysed for specific sectors, such as agrifood systems. Digital inclusion is a dynamic concept that evolves with the advancement of digital technology, changes in digital inequalities and the processes of digitalization. Therefore, it is crucial to periodically reassess these three factors across sectors and contexts.

FIGURE 1

The three factors that lead to digital exclusion when combined



Source: Authors' own elaboration

The process of digitalization has led to the restructuring of various aspects of social life around digital communication and media infrastructures (Brennen and Kreiss, 2016). Understanding the impact of digitalization across sectors in rural areas is crucial for the goal of improving development outcomes for smallholder farmers and ensuring food security. As a greater share of economic, social and civic activities are mediated by digital technologies, it is important to examine the rapid digitalization occurring in sectors that significantly affect the livelihoods and well-being of smallholder farmers.

Even before the COVID-19 pandemic, digitalization was reshaping services across the private, government and civil society sectors, making offline access to services increasingly challenging (Hernandez and Roberts, 2018). The pandemic has accelerated this trend as organizations have shifted their services online due to social distancing and lockdown measures. As digitalization progresses, individuals with sufficient digital access and skills have been able to engage with digital agriculture services, social media marketplaces, digital government services, digital social protection, online education and other digital services. However,

rural populations, particularly women and marginalized groups in rural areas, have been found to be less likely to participate in these sectors when services were digitalized during the pandemic (Arathoon, Raithatha and Tricarico, 2021; Barattini *et al.*, 2022; Braesemann *et al.*, 2022; UN, 2022).

Over the past 25 years, research on the digital divide has revealed that uneven well-being outcomes from digitalization exist not only between individuals who have access to technology and those who do not (referred to as the first-level digital divide; Robinson *et al.*, 2020). There are also differences within the large group of people categorized as “internet users” or “device owners” (known as the second-level digital divide). Furthermore, even among users with similar access to technology and digital skills, evidence shows that individuals who are better off and have greater access to offline economic resources, human capital, social capital and other resources can extract more value from technology compared to less privileged users (known as the third-level digital divide; Helsper, 2021; Ragnedda and Rui, 2017).

The persistence of the three levels of the digital divide between urban and rural areas, men and women, and better-off and marginalized groups has significant implications for FAO and its partners in their efforts to improve the prospects of rural communities in low-income countries (LICs) and LMICs to benefit from digitalization and to avoid digital exclusion.

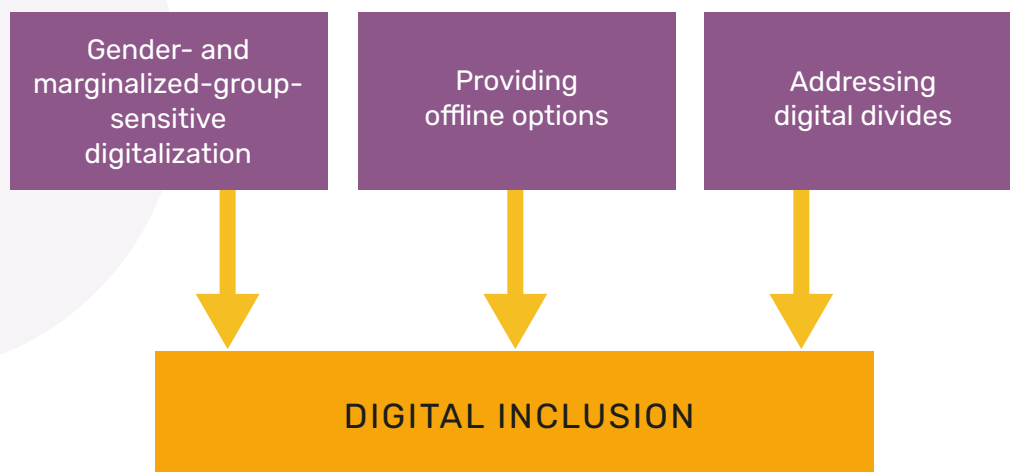
First, rural residents in LICs and LMICs are significantly less likely to have access to digital infrastructure and devices, and they face various barriers to owning digital technologies and accessing the internet, such as affordability, lack of identification required for purchasing a SIM card, or limited access to electricity. This lack of access to digital technology creates a significant gap between rural and urban areas.

Second, access to digital technology alone is not enough for rural communities to be considered “digitally included.” They are also more likely to face significant after-access barriers that limit their ability to fully utilize the internet. These barriers include slow internet speeds, insufficient data, intermittent access, lack of digital skills, reliance on others for connectivity, and the use of subpar devices. These after-access barriers have received less attention in the international development community, and rural women and other marginalized groups in rural areas are particularly affected by them. Addressing these barriers is essential for achieving digital inclusion and enabling rural communities to utilize digital technologies for essential activities that can improve their well-being.

Third, even when after-access barriers are addressed, rural communities and marginalized groups tend to extract less value from their use of the internet due to limited access to economic resources, social capital, human capital, education and other resources that can be leveraged online to improve well-being. In

contrast, better-off groups are better positioned to benefit from digital technology, further amplifying inequalities. This risks deepening spatial inequalities between rural and urban areas and leave rural populations further behind. Bridging this gap and reducing spatial inequalities is crucial for rural development and achieving the overarching goal of leaving no one behind, as outlined in the 2030 Agenda and SDG 10 on reducing inequalities.

Ultimately, is there any good practices or experience that can promote digital inclusion? Our study has identified some solutions, that in theory, are the key areas that must be prioritized. These solutions are grouped into three categories based on the report's digital exclusion framework: gender and marginalized group-responsive digitalization, offline participation options and addressing digital divides (see Figure 2 below). While actions addressing any factor can contribute to digital inclusion, addressing all three factors simultaneously is more likely to result in an inclusive digital rural transformation. This entails tailored digital solutions that meet the needs of all smallholders, ensuring they have adequate digital connectivity to fully participate in society and providing the option to use offline alternatives based on their preferences, needs and priorities. In practice, FAO and other development actors have already adopted numerous effective practices and solutions which are worthy of reference. However, there is significant scope for these efforts to be expanded and implemented in a holistic and collaborative manner.

FIGURE 2**Ways to improve digital inclusion**

Source: Authors' own elaboration



Addressing
all three factors
simultaneously is
more likely to result
in an inclusive
digital rural
transformation.

The report acknowledges that rural geographies and populations within rural areas are not homogeneous regarding development levels and the experiences of different groups. Gender inequalities, compounded by other social differences such as class, race, age and disability, shape access, use and benefits of digital technologies and services for rural women and men. Women smallholder farmers in LICs and LMICs, in particular, face “multiple divides” encompassing digital, rural and gender divides, further marginalizing them regarding information and communications technology (ICT) access and use. The report uses an intersectional inequality lens to analyse digital inclusion and divides whenever possible. However, there is a lack of disaggregated data and evidence on the experiences of marginalized groups in rural areas, creating a blind spot for development organizations and policymakers. While gender disaggregated data tends to be more available, data for other marginalized groups, such as Indigenous Peoples, migrants, racial and ethnic minorities, persons with disabilities and those living in extreme poverty, is scarce, especially in an internationally comparable format.

It is essential to recognize that comprehensive rural digital-inclusion data and research are currently limited. The report was conducted between August and December 2022 and may not cover data and reports published after this period. It focused on published resources related to the digital divide, digital inequalities, digital inclusion and rural development. Resources came from over 300 journal articles, reports, consultations and supplementary materials from esteemed academic journals accessible through platforms, employing snowballing methods for thorough exploration. FAO provided FAO-specific case studies found in the boxes to further contextualize the report.

This report is organized into five sections. This introduction is followed by Section 1 which provides a brief overview of the ongoing digitalization in various sectors, emphasizing the omnipresent threat of digital exclusion for rural populations. Section 2 provides a deep dive into the digital divide between urban and rural areas, with particular emphasis on how it affects women and marginalized groups using the three levels of the digital-divide framework. Section 3 presents several interventions that rural development actors can utilize to improve digital inclusion. The final section concludes the report and provides recommendations.



Ecuador

Freshly caught fish arrives at the artisanal Fishery Cooperative of Santa Rosa de Salinas.

©FAO/Camilo Pareja

1 DIGITALIZATION ACROSS SECTORS IN RURAL AREAS

DIGITALIZATION, CHARACTERIZED BY THE RESTRUCTURING OF VARIOUS ASPECTS OF LIFE around digital communication and media infrastructures (Brennen and Kreiss, 2016), has become increasingly pervasive, impacting economic, social and civic domains. Smallholder farmers, as key stakeholders in rural areas, are involved in agrifood systems and participate in other sectors, such as government services, education, health care, and humanitarian aid.

The implications of digitalization extend beyond the realm of agrifood systems, as smallholders rely on non-agricultural services and opportunities to interact with the state, cope with shocks, maintain their health, acquire digital skills, secure employment and generate income for reinvestment in their agricultural operations. Neglecting the broader impact of digitalization on smallholders would be short-sighted, considering the interconnectedness of their livelihoods and the various sectors they engage with. Recognizing the holistic nature of smallholders' engagement with digitalization is crucial to effectively addressing the challenges of digital exclusion they may encounter.

This section offers a glimpse into the expanding influence of digitalization on people residing in rural areas across different sectors. It highlights shifts in sectors directly related to rural livelihoods, such as agrifood systems and social commerce, along with government services encompassing e-government and social protection. Additionally, the impact of digitalization on humanitarian assistance and education is explored. However, it is important to note that this section serves as an introductory overview rather than an exhaustive analysis of the current state of digitalization in each sector, including digital agriculture. Numerous other sectors, including health, water, sanitation, and hygiene, energy, finance, private services, civil society and education, also significantly affect the lives of rural populations in LICs and LMICs and are also undergoing digital transformations.

The three factors contributing to digital exclusion – digitalization that is non-responsive to the needs of rural residents and marginalized groups, the absence of offline options, and persistent digital divides – are prevalent across the sectors examined in this section. Nevertheless, a comprehensive analysis is required to encompass the broader range of sectors impacting rural livelihoods. Recognizing the multifaceted impact of digitalization underscores the need for FAO and its partners to adopt a holistic approach to effectively address poverty, hunger and inequality, as it acknowledges the interconnectedness of smallholders with various sectors beyond agrifood systems and acknowledges the importance of emphasizing rural poor, small-scale producers and marginalized and vulnerable women and men, including young people, persons with disabilities, migrants and displaced peoples, Indigenous Peoples, as well as communities and other local organizations, in the digitalization process.

It is crucial to recognize that digital exclusion is not uniformly experienced by all individuals living in rural areas. Spatial and group-based factors contribute to certain rural areas and social groups being more exposed to the threat of digital exclusion than others. FAO has identified specific rural areas that are particularly vulnerable to limited access, including very remote communities, areas with large Indigenous Peoples, and regions with high poverty rates, particularly in LDCs (Trendov, Varas and Zeng, 2019a).

In economic terms, as pointed out in the study by Schroeder, Lampietti and Elabed. (2021, p. 14), “remoteness hampers economic growth.” Certain characteristics further exacerbate digital exclusion in rural areas. Remote islands, areas with limited physical connectivity to major cities, regions far from border crossings, and locations that have struggled to attract government or private investment are particularly susceptible to digital exclusion. Conversely, rural areas situated near cities, with better transportation links, and those that have received significant investment tend to have better access to digital technologies (Abay *et al.*, 2020; Akbar *et al.*, 2022; Chamberlin, Pender and Yu, 2006; Herrmann, 2017; Kaiser and Barstow, 2022; Kim and Nangia, 2010; Schroeder, Lampietti and Elabed, 2021). Additionally, within a village or rural area, it is not uncommon for certain parts to have access to digital infrastructure or internet connectivity, while others lack such access (Mason *et al.*, 2022). Unfortunately, there is a dearth of data on variations in digital technology availability and other factors related to the three levels of the digital divide between different rural areas within countries and within specific rural areas. Consequently, Section 1 and Section 2 cannot fully account for these differences, but readers should be mindful of them.

In addition to spatial disparities in digital technology access, not all groups within rural areas have equal opportunities to access digital technologies, even when available. Women and marginalized groups residing in rural areas are more likely to face digital exclusion due to their heightened vulnerability across the three levels of the digital divide (as discussed in Section 2).



Exposure to digital exclusion is context-specific and shaped by local, national and international actors

The degree of digitalization and exposure to digital exclusion is context-specific and shaped by local, national and international actors and their decisions regarding digitalizing content, services and processes. Digital solutions cannot single-handedly determine or reduce exposure to digital exclusion. Mapping the local and national digital landscapes within sectors highly relevant to smallholder farmers can help to identify potential partners who may require influence or technical assistance to ensure that their services meet the needs of smallholders. Collaboration among government entities, private sector organizations, development agencies and civil society actors is essential. Furthermore, digital solutions must be responsive to gender, youth, Indigenous Peoples, those living in poverty and other vulnerable, excluded, or marginalized groups.

1.1 Digitalization of agrifood systems

Agriculture and food continue to be significant sectors of employment worldwide, particularly in LICs and LMICs. In LICs, agriculture accounts for slightly over half of total employment, while in LMICs, it represents just over a third (IFAD, 2021). Rural areas also have a higher proportion of agricultural employment. The broader agrifood systems employs an even larger workforce, comprising approximately 70 percent of all employment in LICs and LMICs (World Bank, 2022a). Consequently, any changes or transformations in agrifood-systems practices have a significant impact on people living in rural areas of LICs and LMICs.

Digital agriculture⁹ solutions, which encompasses a wider array of technologies comparing to 'E-agriculture' solutions driven by ICTs, are increasingly being recognized as catalysts for the transformation of agrifood systems. These solutions offer the potential to help farmers reduce costs, enhance yields, access new markets, find better prices for their products, and ultimately increase their incomes (Schroeder, Lampietti and Elabed, 2021). A forum on digital agriculture co-hosted by FAO in 2020 highlighted the capacity of digital agriculture to contribute to a wide range of SDGs (FAO and Zhejiang University, 2020).

However, it has been acknowledged that larger, wealthier, and more educated farmers tend to be more involved in and benefit from digital agriculture compared to small-scale farmers (World Bank, 2019a). Therefore, digital agriculture interventions should carefully address and mitigate these inequalities in access to human and other resources. As Schroeder, Lampietti and Elabed (2021, p. 35) emphasize, "While digitalization promises to bridge divides in rural areas, it can exacerbate them if not well managed."

⁹ Source: <http://breakthrough.unglobalcompact.org/disruptive-technologies/digital-agriculture/>

BOX 1

Digitalizing the milk supply chain in Kazakhstan

The Inclusive Dairy Value Chain Development Project implemented by FAO in partnership with the European Bank for Reconstruction and Development (EBRD) in Kazakhstan aimed to digitalize the suppliers of raw milk in the country's dairy industry. The project utilized a free mobile app called Collect Mobile to collect data and information on milk output, procurement, supply structure, number of suppliers, number of cows and productivity across villages. This data was analysed through a dashboard, offering a fast and user-friendly data collection method and improving data quality in the dairy industry.

The app plays a crucial role in helping smallholder farmers meet industry standards and remain part of the dairy supply chain. Since dairy factories in Kazakhstan source milk from numerous small farms, the app improves supply chain management by providing better information on safety parameters and procurement quantities. In turn, this enhances support for small-scale farmers.

Additionally, FAO and EBRD collaborated to launch **Ақылды сүт** ("smart milk"), a comprehensive online platform focused on good farming practices and food safety throughout the dairy value chain



©FAO/EBRD joint project

in Kazakhstan. Maintained by the Dairy Union of Kazakhstan, the platform offers access to relevant knowledge and guidance for dairy farmers, milk collectors, milk processors and even consumers. The resources available on the platform include video tutorials, a farmer's resource book, animations and posters in both Kazakh and Russian. Topics covered range from maintaining cow health and wellbeing, to proper workspace and utensil disinfection, as well as the significance of consuming safe and antibiotic-free milk. This knowledge can be accessed anytime and anywhere through a smartphone or tablet.

"DIGITAL AGRICULTURE is the use of new and advanced technologies, integrated into one system, to enable farmers and other stakeholders within the agriculture value chain to improve food production." The UN Digital Compact definition encompasses a broader range of technologies and strategies that utilize digital tools and data-driven solutions to optimize various aspects of farming and agricultural practices.

This subsection provides an overview of digitalization trends observed in the agricultural and agrifood sector. It presents the various use cases and applications through which agricultural services are being digitized and rolled out. It also discusses the challenges faced by small-scale farmers in accessing these newly digitalized agricultural services. It is worth noting that there are several other reports available that offer more detailed analyses of digitalization in the agricultural sector, including studies by Arathoon, Raithatha and Tricarico (2021), Schroeder, Lampietti and Elabed (2021), Trendov, Varas and Zeng (2019b), and the World Bank (2019a).

There are seven primary use cases for digital agriculture:

- **Smart farming:** "refers to managing farms using modern information and communications technologies to increase the quantity and quality of products while optimizing the human labour required" (Sciforce, 2023, para. 2). Relevant technologies include sensors, software, connectivity, location,¹⁰ robotics, and data analytics. However, "[t]he driving force of smart farming is IoT [internet of things] – connecting machines and

¹⁰ The term "location" here covers also geospatial enablement and/or geospatially enabled communities and society; such enablement is achieved through Spatial Data Infrastructures (foundational, authoritative digital geospatial data, services and applications, and interoperability standards) and Geospatial Knowledge Infrastructure (knowledge creation and foresight) cf. <https://ggim.un.org/IGIF/> and <https://geospatialmedia.net/pdf/GKI-White-Paper.pdf>

BOX 2

ChispaRural.gt acts as an online agricultural business incubator for rural Guatemalan youth

Under FAO's Integrated Country Approach for boosting decent jobs for youth in agrifood systems, the organization has supported the digital engagement of rural youth in Guatemala through the ChispaRural.GT platform. This platform aims to increase access to information, training and marketing opportunities for rural youth, while also fostering peer learning and networking. The development of ChispaRural.gt was based on assessments of the communication ecosystem of rural youth to ensure it meets their needs (FAO, 2022a; Pafumi and Arimbi, 2022).

ChispaRural.gt provides a range of services, tips

and practical tools for rural youth, offering them a space to exhibit their products and services for free. As of the end of 2022, the platform had an average of over 560 weekly web users, 365 registered users, 1 630 Facebook followers and a WhatsApp group with over 158 members. The current version of ChispaRural.gt includes new services such as la Vitrina, featuring 65 agribusinesses and eight success stories, along with audiovisual content. It also includes Chispa Lab, where online trainings are provided based on the demands of youth, covering topics such as value chains and digital security (ChispaRural.gt, 2022).

Sources: ChispaRural.gt. 2022. Jóvenes con Chispa. In: *ChispaRural.gt*. [Cited 29 March 2024]. <https://chisparural.gt/categorias/agentes-de-cambio>

FAO. 2022. *Identikit of the East African youth agripreneur in the digital space*. Factsheet. Rome. <https://www.fao.org/3/cb9297en/cb9297en.pdf>

Pafumi, M. & Arimbi, V. 2022. Ready to go digital? Assessing the digital readiness of young agripreneurs in East Africa. Nairobi, FAO. <https://doi.org/10.4060/cb8026en>

E-AGRICULTURE

is seen as an emerging field focusing on the enhancement of agricultural and rural development through improved information and communications processes. In this context, ICT is used as an umbrella term encompassing all information and communications technologies including devices, networks, mobiles, services and applications; these range from innovative internet-era technologies and sensors to other pre-existing aids such as fixed telephones, televisions, radios and satellites (FAO and ITU, 2016).

sensors integrated on farms to make farming processes data-driven and automated" (Sciforce, 2023, para. 5). Through the use of the internet, the farming process can be optimized as follows: "IoT devices installed on a farm should collect and process data in a repetitive cycle that enables farmers to react quickly to emerging issues and changes in ambient conditions" (Sciforce, 2023, para. 6).

- **Farm management:** in a digital context, a farm management information system refers to "a system for storing and processing farm-related collected data, provide support to farmers for decision making in every-day farm management" (Karydas *et al.*, 2023, p. 2).
- **Access to knowledge and advisory services:** "Digitally delivered information on topics such as agronomic best practices, pests, and diseases, weather and market prices, as well as more sophisticated digital advisory services and farm management software tailored to the specific farmer, farm or field" (Tsan *et al.*, 2019, p. 35).
- **Access to markets:** this includes "link[ing] smallholder farmers to high-quality farm inputs (e.g. seeds, fertilizers, herbicides/pesticides), production and post-harvest machinery and mechanization services (e.g. irrigation, tractors, cold storage), or off-take markets, including agro-dealers, wholesalers, retailers, or even to end-consumers." (Tsan *et al.*, 2019, p. 35).
- **Access to finance:** includes access to "digital payments, savings, smallholder credit, and agricultural insurance" (Tsan *et al.*, 2019, p. 35).

- **Supply chain management:** “business-to-business services that help agribusinesses, cooperatives, nucleus farms, input agro-dealers, and other smallholder farmer value chain intermediaries to manage their smallholder relationships” (Tsan *et al.*, 2019, p. 35).
- **Governance and intelligence** (or macroagricultural intelligence): “Data analytics solutions and digital decision support tools that integrate a variety of data sources on smallholder farmers, farms and markets and convert this information into useful country- and value-chain level insights and decision tools for government policymakers, extension agencies, agronomists, agribusinesses and investors.” (Tsan *et al.*, 2019, p. 35). Governance of digital services includes guidelines on the governance of digital data, including secure storage of agricultural data, as well as transparency on the usage of their data, and access to beneficial but anonymously stored data (see, for example, BLW, 2018; Gugganig and Bronson, 2022).

It needs to be noted that these use cases are aimed at providing a broad overview and do not cover all possible applications and technologies within the field of digital agriculture.

In the past, digital agriculture initiatives, particularly in Asia and Africa, have primarily focused on advisory services. However, there has been a shift towards bundling information and advisory with other digital agriculture activities. For instance, more than 50 percent of digital agriculture solutions in Africa included bundled services across multiple use cases by 2019 (Arathoon, Raithatha and Tricarico, 2021; Tsan *et al.*, 2019). Additionally, several digital agriculture super platforms have emerged, offering services across various categories (Tsan *et al.*, 2019).

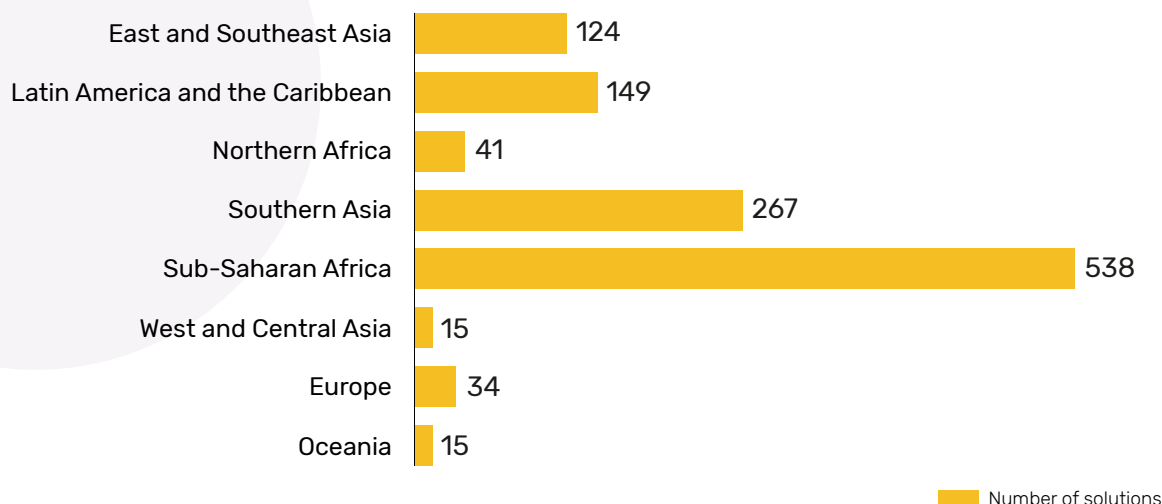
Over the past decade, the digitalization of the agricultural sector has gained momentum. The number of digital agricultural solutions launched in LICs and LMICs increased from 209 in 2013 to 946 as of March 2023, as indicated in Figure 3, according to data from Wageningen University’s database (Digital Agri Hub, 2024). However, the rate of new solution launches has slowed, with only 11 new solutions launched in 2022. Figure 4 illustrates that sub-Saharan Africa (SSA) and Southern Asia have launched the most digital agriculture solutions, with 538 and 267 solutions, respectively. The Latin America and Caribbean (LAC) and East and Southeast Asia regions follow closely in terms of solution launches. It is worth noting that India accounts for a significant proportion of solutions launched in Southern Asia, representing over 80 percent of the total, while Bangladesh ranks second with just under 20 percent. In other regions, Kenya leads in SSA, Indonesia in East and Southeast Asia, and Colombia in LAC (Digital Agri Hub, 2024).

Engagement with digital agriculture solutions varies significantly among different groups, as shown in Figure 4. In SSA, a large proportion of users are smallholders, accounting for 84 percent of the total, whereas in Southern Asia, this proportion is less than half at 33 percent (Digital Agri Hub, 2024). In West and Central

Asia, Oceania and Northern Africa, digital agriculture solutions are exclusively used by smallholders, although these regions have a limited number of solutions implemented. In LAC, over half of the users are smallholders.

FIGURE 3

Number of digital agriculture solutions implemented per region (lower middle-income countries only)

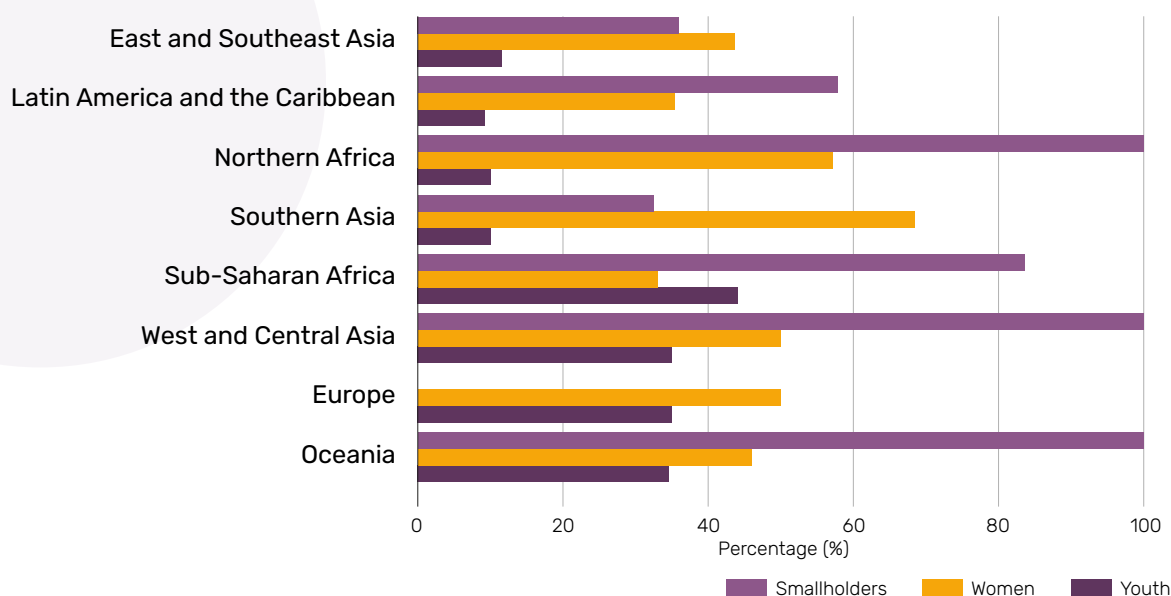


Note: Data presented reflects information gathered in December 2022

Source: Digital Agri Hub. 2024. 2024. Dashboard. In: *Digital Agri Hub*. Wageningen, The Kingdom of the Netherlands. [Cited 28 March 2024]. <https://digitalagrihub-test.containers.wur.nl/web/guest/dashboardframe>

FIGURE 4

User percentage of digital agriculture solutions by group and region (lower middle-income countries only)



Note: Data presented reflects information gathered in December 2022. Data for percentage of smallholder users in Europe is not available

Source: Digital Agri Hub. 2024. 2024. Dashboard. In: *Digital Agri Hub*. Wageningen, The Kingdom of the Netherlands. [Cited 28 March 2024]. <https://digitalagrihub-test.containers.wur.nl/web/guest/dashboardframe>

In terms of gender, women represent the majority of users in Southern Asia, and interestingly, in Northern Africa, where women's participation in the labour market is typically lower than that of men (ILO, 2019). The proportion of female users is lowest in SSA and LAC, possibly reflecting the lower involvement of women in the agricultural sector, particularly in LAC (Global Agriculture, n.d.).

Regarding youth involvement, it is highest in the SSA region. While SSA is known to have the world's youngest population, the higher youth involvement rates in this region cannot be solely attributed to demographics. In contrast, youth involvement barely reaches 10 percent in Southern Asia and is even lower than 10 percent in LAC. The difference with Southern Asia may be due to the relatively lower targeting of smallholders in that region compared to SSA and the challenges young people face in accessing land, as they typically have more difficulty than older adults (FAO, CTA and IFAD, 2014). However, a more in-depth analysis is necessary to better understand how usage patterns affect farmers from different demographics.

The COVID-19 pandemic has had a significant impact on the adoption and expansion of digital agriculture initiatives worldwide, as noted by the Global System for Mobile Communications Association (GSMA) (Arathoon, Raithatha and Tricarico, 2021). With in-person agricultural advisory services coming to a halt due to lockdown and social distancing measures, governments, non-governmental organizations (NGOs), and agribusinesses had to find alternative ways to reach farmers with information related to farming and the pandemic. This led to the use of a combination of offline mechanisms such as radio, TV, loudspeakers and printed media, as well as digital channels including short message service (SMS), interactive voice response, social media and digital agriculture apps.

Access to markets became more challenging for farmers, prompting an increased demand for market linkage tools from digital agriculture initiatives that previously focused primarily on providing advisory services. The pandemic also amplified the need for agricultural e-commerce among consumers, smallholder farmers and the agricultural sector as a whole. The closure of the hospitality sector severely disrupted business-to-business (B2B) agricultural supply chains, including those that heavily relied on digitalization. To mitigate losses, many agritech companies pivoted and established digitalized business-to-consumer (B2C) sales channels. Consequently, digital agriculture solutions focusing on market linkages shifted their focus from selling to businesses to selling directly to consumers.

Additionally, most digital agriculture applications incorporated COVID-19 advisory services to assist farmers in adapting to changing regulations and practices during the pandemic. These apps provided updates on market closures, revised schedules, exemptions for agricultural activities during lockdowns, and

guidance on navigating challenges arising from inaccessible markets, such as storing unsold food and utilizing alternative organic inputs (Arathoon, Raithatha and Tricarico, 2021). Adding COVID-19 advisory services also served as a way to combat the spread of fake news. However, farmers who lacked sufficient access to digital services were excluded from the new offerings and relevant COVID-19 information crucial to their livelihoods, health and ability to navigate through misinformation.

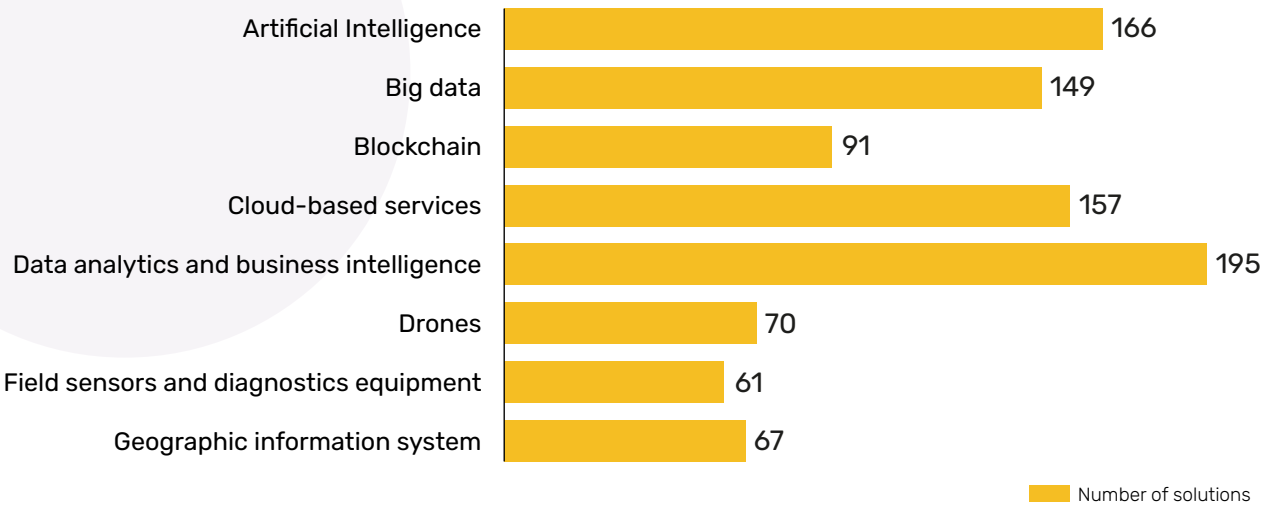
The lack of access to technology is a major barrier preventing digital agriculture services from reaching more smallholder farmers, as highlighted by Tsan *et al.* (2019). Chandra and Collis (2021) identified various barriers to the adoption of digital agriculture among smallholders in LICs and LMICs, including connectivity and access, affordability, literacy and skills, timely and relevant information, and data trust and security. Similar to mobile network operators, which primarily operate in urban areas due to lower investment costs and the higher purchasing power of urban populations, digital agriculture initiatives also tend to focus on more profitable market segments. This unequal distribution of digital agriculture solutions poses a threat to exacerbating the digital divide in geographies and communities that are more difficult to reach.



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The level of technology, skills and resources required to engage with digital agriculture is continuously evolving. In 2019, one-third of respondent companies in Africa offering digital agriculture solutions were already using advanced technologies such as blockchain, machine learning, drones, IoT, big data, satellite positioning, remote sensing, and others, and nearly 60 percent expected to implement advanced technologies by 2022 (Tsan *et al.*, 2019). Globally, a wide range of emerging technologies are already in use, as depicted in Figure 5. Data analytics and business intelligence are the most widely used emerging technology in digital agriculture in LICs and LMICs (20.6 percent), followed by artificial intelligence (17.5 percent), cloud-based services (16.6 percent), and big data (15.8 percent) (Digital Agri Hub, 2024). Other advanced technologies like blockchain, remote sensing, foundational authoritative geospatial datasets and drones are also commonly employed.

FIGURE 5
Number of digital agriculture solutions launched by type of emerging technology (lower-income and lower middle-income countries only) (n = 946)



Note: Data presented reflects information gathered in December 2022
Source: Digital Agri Hub. 2024. 2024. Dashboard. In: *Digital Agri Hub*. Wageningen, The Kingdom of the Netherlands. [Cited 28 March 2024]. <https://digitalagrihub-test.containers.wur.nl/web/guest/dashboardframe>

However, as these solutions increasingly rely on advanced technologies, the hardware and digital skills required by farmers to fully utilize them are likely to increase. Prior to the pandemic, Tsan *et al.* (2019) already observed that sophisticated management software solutions were commonly used by large farms in developed countries and were becoming more accessible to large farms in developing countries. A report for the G20 in 2022 emphasized the persistence of unequal capacities to implement precision agriculture between developed and developing countries, as well as between large and small farms, which could further exacerbate spatial, social and economic divides (Anbumozhi *et al.*, 2022).

Numerous challenges to expanding precision agriculture to developing countries have been identified including: a lack of technological infrastructure, limited access to digital equipment, inadequate internet and electricity access, fragmented informal value chains, low levels of digital literacy, insufficient data regulation and governance mechanisms for emerging technological solutions, capacity gaps in national agricultural ministries, and a lack of awareness about digital solutions (Anbumozhi *et al.*, 2022). Smallholder farmers, especially female smallholder farmers, are significantly less likely to benefit from these solutions, posing risks of increasing income inequality between smallholder and large farms within LMICs (Hackfort, 2021). Additionally, there is a concern that smallholder farmers could lose their jobs due to automation if digitalization interventions are introduced without adequate locally-rooted self-sufficient agricultural skills (Schroeder, Lampietti and Elabed, 2021).

Farmers, small and medium-sized enterprises and microentrepreneurs are increasingly utilizing social media platforms such as Facebook, WhatsApp, Twitter, TikTok, Instagram, and WeChat to market and sell their goods and services (Caribou Digital and Qhala, 2020). In LICs and LMICs, the use of social media for establishing an online presence, marketing products and driving sales far surpasses the usage of traditional e-commerce platforms. For instance, in Kenya, Facebook is reported to be the most popular online forum for buying and selling agricultural produce, surpassing the activity levels on existing agricultural marketplace platforms (Barrie and Wills, 2016). Facebook farming groups, with memberships of up to 40 000 individuals consisting of both buyers and sellers, demonstrate significant engagement on social media.

Social media platforms may offer a more inclusive environment for economically disadvantaged farmers and entrepreneurs compared to formal digital agriculture and e-commerce platforms. Many digitally connected small businesses predominantly rely on Facebook, WhatsApp and other consumer platforms to cater to their increasing commercial needs. “Social commerce,” is often hailed as a means of levelling the playing field, as even the smallest businesses can utilize social platforms at a low cost (Pon, 2020). Unlike digital agriculture platforms, interactions on social media platforms typically incur minimal monetary costs, enabling individuals to promote their businesses, labour, or products for free (as long as they can afford being online). For example, small and microenterprises can directly contact potential customers through Facebook Marketplace or Facebook groups. However, most social media platforms do not provide integrated payment services, requiring farmers to supplement them with digital finance solutions or conduct in-person transactions with clients (Caribou Digital and Qhala, 2020).

Although social media platforms offer potential opportunities, there are certain challenges associated with earning income through the sale of goods on these platforms. The stability of income can be uncertain, and individuals with higher levels of digital skills and larger social networks tend to have an advantage in capturing sales. Referrals from friends and family, through resharing and tagging, play a significant role in increasing the visibility of social media posts. Building trust can also be a hurdle in this context. Establishing prior in-person relationships with participants in social media groups can help foster trust and enhance sales prospects (Caribou Digital and Qhala, 2020). Moreover, evidence suggests that English proficiency is advantageous for navigating platforms like Facebook to access international markets through these channels (Caribou Digital and Qhala, 2020; Jack, Chen and Jackson, 2017). It is important to recognize the potential risks of misinformation or unreliable content shared within farmer groups on Facebook. While social agriculture and social commerce are likely prevalent, data on these practices, especially among rural populations, is scarce (Schoemaker, 2021). However, ongoing efforts by organizations such as Caribou Digital aim to address these knowledge gaps in the field.

1.2 Digitalization of government services and social protection systems

1.2.1 Government services

Smallholder farmers – as citizens, residents and sometimes beneficiaries – often rely on government and non-state actor services, such as humanitarian organizations, NGOs and development organizations. These services can range from promoting investment and productivity through land-titling, input subsidies, and extension services (including skills development and microfinance linkages), to social protection measures like food transfers, food subsidies, cash transfers and public works schemes. Some programmes aim to uplift smallholders out of poverty and improve their livelihoods, known as graduation or “cash plus” programmes (Lind, Sabates-Wheeler and Szyp, 2022; Tirivayi, Knowles and Davis, 2016).

Government services worldwide are undergoing rapid digitalization. The United Nations’ E-Government Development Index (EGDI), published biennially since 2001, tracks the progress of digital government services across 193 UN Member States. The index reveals a consistent increase in the number of countries offering digital services and the range of services available (United Nations, 2022). In 2022, 189 out of 193 UN Member States had national online portals providing information and services, with at least one transactional service available online. This represents a substantial growth compared to the first index in 2001, when only

36 countries had portals and only 17 offered online transactions for citizens (United Nations, 2001). Presently, countries offer an average of 16 out of the 22 services tracked by the EGDI, and some countries and subnational governments even provide access to hundreds of digital services.

A notable trend is the establishment of “one-stop shops” which are government portals offering citizens the convenience of applying for services from all ministries and agencies in one place. By eliminating the need to physically visit different locations during working hours, these one-stop shops simplify the process for citizens and residents. Users no longer need to determine which government department provides a specific service nor create separate accounts for each department. Instead, they can access all services through a single sign-on. The availability of one-stop shops has significantly increased, with 72 percent of UN Member States and over half of the analysed cities introducing this digital service delivery model by 2022 (United Nations, 2022). This marks a substantial growth from 2014 when only 37 percent of UN Member States offered one-stop-shop digital services (United Nations, 2014).

However, significant disparities exist in e-government service availability, comprehensiveness and access both between and within countries. A strong and notable correlation is observed between country income levels and their scores on the EGDI (see Table 2 below). The 15 countries with “very high” EGDI scores are exclusively high-income countries (HICs). While improvements in EGDI scores have been consistent across all income groups, LMICs and upper-middle-income countries have witnessed the most rapid progress in the recent e-government index, indicating some convergence between HICs and middle-income countries (MICs) (United Nations, 2022). LICs have shown improvements in EGDI, outpacing HICs but lagging behind MICs, indicating their continued progress at a slower pace.

TABLE 2

E-Government Development Index scores by income group

COUNTRY GROUPING BY INCOME	EGDI AVERAGE (OUT OF 1)
Low income	0.2963
Lower middle income	0.4562
Upper middle income	0.5725
High income	0.7542
Average	0.5554

Source: United Nations, 2022. *United Nations E-Government Survey 2022: The future of digital government*. New York, USA, United Nations Department of Economic and Social Affairs. <https://tinyurl.com/28a3knpk>

The 2022 EGDI highlights the widespread utilization of digital technologies by governments to provide services in response to the pandemic. Around 90 percent of UN Member States employed digital portals to disseminate information and deliver services (see Table 3 below) aimed at mitigating the impact of COVID-19 (United Nations, 2022). Online services related to COVID-19 encompassed distance learning, telehealth, vaccine scheduling and COVID-19 test scheduling. However, there is evidence suggesting that digitalized COVID-19 measures lacked inclusivity. Individuals without access to digital technologies encountered difficulties in accessing information and services related to the pandemic.

For instance, in India, the automation of vaccine appointments primarily benefited wealthier individuals with better connectivity in urban areas, enabling them to secure vaccine slots in rural areas before rural residents could become aware of them amid vaccine shortages. Additionally, opportunistic actors with advanced digital skills exploited bots to monopolize all vaccine slots and then charged people for appointments that the government was offering for free, further disadvantaging impoverished and rural residents (Bansal, 2021).

TABLE 3
Countries offering services related to COVID-19 in 2022

COUNTRIES THAT OFFERED SERVICES AND CONTENT RELATED TO:	NUMBER OF UN MEMBER STATES (OF 193)
Distance-learning platforms or related information	141
Telehealth scheduling or services	99
COVID-19-vaccine information and scheduling	156
Schedule medical test or obtain information about medical tests	102

Source: United Nations. 2022. *United Nations E-Government Survey 2022: The future of digital government*. New York, USA, United Nations Department of Economic and Social Affairs. <https://tinyurl.com/28a3knpk>

The e-government survey has recently introduced the Local Online Services Index (LOSI), which evaluates the e-government presence of the most populous city in each country. The survey findings reveal that local governments generally have a less prominent online presence and offer fewer digital services compared to national governments. Notably, a concerning trend identified by the survey is the strong correlation between a city's size and its LOSI score. Megacities with populations exceeding 10 million tend to perform better on the index, exhibiting a greater online presence and offering a wider range of digital services compared to smaller cities with populations in the hundreds of thousands.

(United Nations, 2022). This trend raises concerns for rural areas, as it suggests that rural citizens may not have equal access to local services online compared to their urban counterparts.

Regrettably, the LOSI assessment has not yet been conducted within cities or regions of the same country. Furthermore, rural areas have not been included in the LOSI framework. In order to address these gaps, collaborating with the United Nations Department of Economic and Social Affairs (UNDESA) is crucial to capture the e-government experiences of rural areas in future LOSI analyses. This would contribute to a more comprehensive understanding of the e-government landscape at the local level and enable targeted efforts to bridge the digital divide between rural and urban areas.

1.2.2 Social protection

The global pandemic has had a devastating impact, leading to a reversal of years of development progress. In 2020, the international poverty rate increased for the first time since 1998, and millions of workers faced unemployment due to lockdowns and social distancing measures (World Bank, 2020). It is estimated that between 88 and 115 million people were pushed into poverty as a result of the pandemic, with marginalized groups being disproportionately affected and becoming part of the “new poor.” The number of people suffering from hunger also significantly increased by approximately 150 million between the start of the pandemic and 2021, after remaining stable since 2015 (FAO *et al.*, 2022). Smallholder farmers were among the hardest hit by the pandemic, experiencing substantial reductions in farm and off-farm income as well as food consumption (Hammond *et al.*, 2022).

Governments responded by expanding social protection programmes to provide relief to those facing hardship. By December 2020, over 1 400 social protection programmes had been planned or implemented in 215 economies, benefiting more than 1.1 billion people (Better Than Cash Alliance, 2021; Gentilini *et al.*, 2020). In 2020, new social protection measures were being added globally at a rate of 180 per week. This rapid expansion of social protection measures has continued, with over 3 800 implemented by 223 economies as of January 2022 (Gentilini *et al.*, 2022).

However, there is a significant “stimulus gap” between HICs, which have been able to mobilize resources to fund the growing demand for social protection, and LICs that lack fiscal space and sufficient social protection coverage to mount a proportionate response. This inequality puts LICs at risk of an uneven recovery (ILO, 2022). Therefore, the pandemic has underscored the importance of strong social protection systems and the establishment of social protection floors to enhance resilience to future shocks and crises.

Digital technologies have been promoted as a tool to expand social protection in a safe, efficient and effective manner in response to the pandemic (Chirchir, 2020). When implemented responsively

Farmer registry in Lebanon supported by FAO

The integration of farmer registries and social protection information systems can have significant benefits in delivering targeted support to smallholder farmers and vulnerable groups. Farmer registries serve as electronic databases that provide detailed information on the demographic and socio-economic status of farmer households, including their asset holdings. These registries are typically managed by agriculture ministries and enable the delivery of tailored support, such as agricultural inputs, training and extension services.

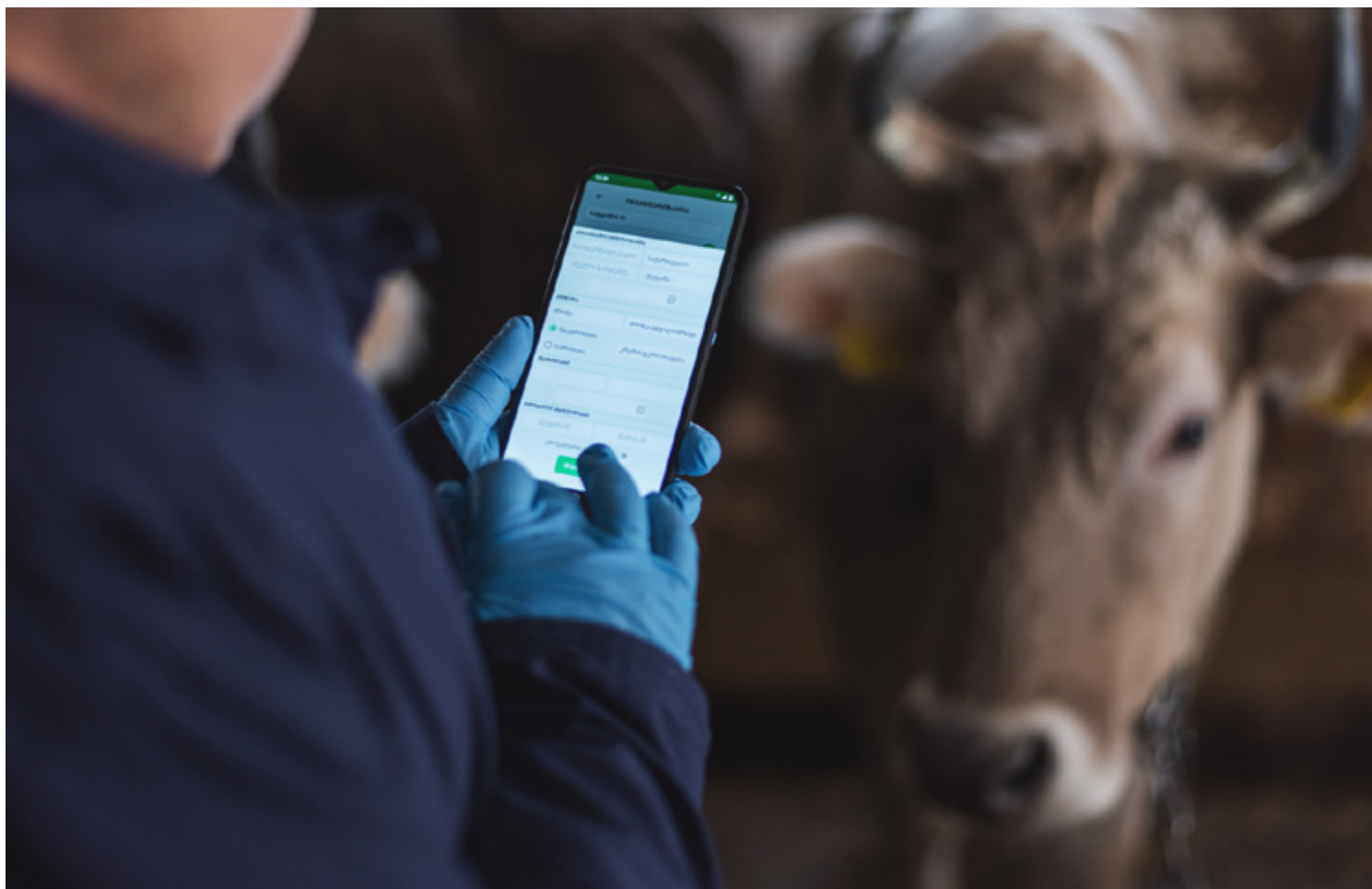
In Lebanon, farmers and fishers are among the country's poorest populations and are often engaged in the informal sector, making them ineligible for national social protection systems. To address this issue and extend social protection coverage to rural populations, the Ministry of Agriculture in collaboration

with FAO and the Ministry of Social Affairs developed a national farmers registry. This registry includes a targeting module specifically designed to identify and assist poor farmers based on a multidimensional poverty index. It complements existing beneficiary registries for social assistance programmes.

By creating a legally recognized registry of vulnerable farmers and fishers, these groups gain access to social safety nets in Lebanon. Furthermore, it serves as a critical step towards their inclusion in the National Social Security Fund and other social insurance schemes. The establishment of a national farmer registry also promotes informed decision-making and policy coherence between agricultural and social protection sectors in Lebanon, ensuring that resources and support are effectively and efficiently directed to those in need.

and inclusively, digital social protection systems can offer benefits for both beneficiaries and governments (Barattini *et al.*, 2022). For governments, digital social protection can reduce administrative costs, minimize duplication and errors, improve data accuracy, enhance coordination of interventions, expedite beneficiary targeting and enhance delivery efficiency. For beneficiaries, digital social protection can reduce time and travel costs. Women can benefit from increased control over benefits and reduced risks of harassment and violence associated with registering and receiving benefits (Barattini *et al.*, 2022).

Currently, there is a lack of internationally comparable data on the level of digitalization of social protection systems both within and between countries. However, a review conducted in 2019 indicated that an increasing number of LICs and LMICs were beginning to digitize aspects of social protection delivery, such as information systems, financial services, and grievance and accountability mechanisms (Carter *et al.*, 2019). Similarly, the UN Special Rapporteur on Extreme Poverty and Human Rights observed that welfare and social protection systems, particularly in HICs and MICs, were undergoing a digital transformation, with some LICs laying the foundations for similar systems (United Nations General Assembly, 2019). Governments were found to be utilizing digital technologies for various purposes, including identity verification, eligibility assessment, benefit calculation, payment distribution, fraud detection and prevention, and beneficiary communication (United Nations General Assembly, 2019). A review by FAO also highlighted that while digital social protection tools existed before the pandemic, their adoption and development have accelerated as a result of the crisis (Barattini *et al.*, 2022).



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The UN e-government survey does not currently provide specific metrics to differentiate digital social protection systems from broader e-government services. However, it has observed a consistent increase in online services offered to vulnerable populations, including youth, women, immigrants, older people, persons with disabilities and those living in poverty, across all regions (United Nations, 2022). However, a lack of digital access and skills can lead to the exclusion of social protection beneficiaries who are unable to access online applications or engage with the government digitally when processes shift online. For instance, in Pakistan, digital methods were used to administer social cash assistance payments to support 12 million of the country's poorest citizens affected by COVID-19. Citizens were required to send a text message to an automated system that used an algorithm to verify their eligibility against a government database. Upon confirmation, they would receive a text message notifying them of their eligibility and could withdraw money from a bank or mobile money agent. Poor rural women were disproportionately excluded due to limited access to mobile phones and lower levels of digital literacy, rendering their needs invisible to the state and underserved (Kemal, 2022).



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Recipients with limited connectivity may struggle to maintain their welfare payments when required to recertify or report conditional activities online (United Nations General Assembly, 2019). A review conducted by FAO found that digitizing social protection can reduce administrative costs and enhance the efficiency, quality and transparency of social protection programmes. However, the review also revealed that these benefits often go unrealized and are undermined in rural areas due to low access to digital technologies, lack of digital skills and payment accounts, insufficient identification and proof of address, and limited access to basic infrastructure. These barriers tend to disproportionately exclude migrants, marginalized ethnic groups, Indigenous Peoples, older people and women living in rural areas. To promote the inclusion of rural populations, digital social protection solutions must be complemented with non-digital service delivery options (Barattini *et al.*, 2022). Similarly, the UN Special Rapporteur on Extreme Poverty and Human Rights cautioned against the transformation of widely used “digital by default” or “digital by choice” policies into “digital only” practices (United Nations General Assembly, 2019). Exclusive reliance on digital platforms for social protection runs the risk of excluding the less fortunate, who are less likely to have access to technology or may have outdated equipment with unreliable digital connections (United Nations General Assembly, 2019). Consistent with the recommendations of

the FAO and this paper, the Special Rapporteur concluded that non-digital options are essential and should always be available. Additionally, he recommended that digital welfare systems be co-designed and evaluated with intended beneficiaries to minimize potential harm.

Instead of being designed to meet the needs of women and marginalized groups, social protection and assistance are increasingly driven by digital data and technologies that automate, predict, identify, surveil, detect and target (United Nations General Assembly, 2019). The design, construction, and operation of the digital welfare state are largely influenced by technology companies without input from the individuals whom social protection systems are intended to assist. This often leads to systems that disempower those in need rather than empower them, shifting the focus from reaching entitled individuals to treating them as potential fraudsters (Eubanks, 2018). This situation arises because many digital systems assess individuals using data analytics to predict “risk scores,” automatically disqualifying potential candidates considered to pose a high risk of fraudulent or criminal activity (United Nations General Assembly, 2019). Furthermore, machine learning algorithms have been shown to replicate societal biases and inequalities by design rather than arriving at objective conclusions that would minimize the prediction of negative outcomes for marginalized groups (Crawford, 2013). Digital welfare systems are primarily driven by cost savings, market-driven efficiency ideals, and fraud reduction (United Nations General Assembly, 2019). The design, implementation and evaluation phases of digital welfare states often do not involve consultation or inclusion of the beneficiaries. The UN Special Rapporteur emphasizes that due to the relative deprivation and powerlessness of many welfare recipients, conditions, demands, and intrusive practices are imposed that would not be accepted if they were piloted in programmes applicable to more affluent community members (United Nations General Assembly, 2019).

1.2.3 Digital humanitarian cash payments

Smallholder farmers, who play a significant role in supplying up to 80 percent of food in Asia and SSA face extreme poverty and comprise half of the world’s hungry population (Nelson, 2020). Unfortunately, they are often excluded from social safety nets and other social protection programmes. Due to their limited financial resources and capacity to respond to crises, such as climate shocks (IFAD, 2022), they are disproportionately vulnerable to shocks and more likely to require assistance during humanitarian crises.

The shift towards cash-based humanitarian assistance, has contributed to increased digitalization in the humanitarian aid sector. Similar to digital social protection, digital humanitarian cash payments are promoted for their potential to be faster, more efficient, transparent, and secure compared to traditional methods (Better Than Cash Alliance, 2021). Even before the pandemic, the humanitarian sector was already transitioning towards providing assistance through cash

Financial inclusion through digital cash payments: FAO's Green Jobs for Rural Youth Employment

Digital tools have been actively utilized under FAO's Green Jobs for Rural Youth Employment project, which aims to promote green employment for rural youth in Timor-Leste, Sierra Leone and Zimbabwe.

In Zimbabwe, Mukuru, a financial service provider offering digital money services, is widely used and known among Zimbabweans. It is currently being used to administer the payment of monthly wages and seed money to youth participants in the project. Digitalization efforts do not only involve beneficiaries but also extend to implementing partners. As mentors, the extension officers supporting the implementation of the youth-led Green Start-Ups have attended

two virtual workshops through digital tools and have been submitting virtual copies of mentoring reports. The project supports their access to digitalization by providing data allowances.

On the other hand, T-pay, a mobile wallet, has been used for seed money grant disbursement and monthly wage payments in Timor-Leste. Also, a one-day workshop was arranged to efficiently support the rural youth beneficiaries with limited digital literacy access to the mobile wallet. The session focused on guiding the youths to effectively utilize the mobile application to purchase stuff in the stores and withdraw cash.

Source: FAO. 2024. Green jobs. In: FAO – Decent Rural Employment. Rome. <https://www.fao.org/rural-employment/work-areas/green-jobs/en/>

and vouchers. In 2019, the amount of humanitarian aid distributed through cash and vouchers had doubled in comparison to two years earlier, reaching 17.9 percent of total humanitarian assistance (USD 5.6 billion). Three UN agencies, namely the World Food Programme (WFP), the United Nations High Commissioner for Refugees (UNHCR) and the United Nations Children's Fund (UNICEF), accounted for half of these humanitarian transfers (CaLP, 2020). Cash transfers typically take one of four forms:

- **Cash in Hand:** the distribution of cash in envelopes to beneficiaries directly.
- **Cash as a Service:** the use of a financial service provider as an intermediary who then distributes cash to beneficiaries.
- **Cash-Based System:** distributing funds through a mobile money or debit card linked to a banking account.
- **Completely digital:** digital value received, which can be spent at digitally-enabled merchants.

Humanitarian aid organizations have increasingly embraced digital cash transfers as part of the shift towards cash-based assistance. These digital solutions, particularly cash as a service and cash-based systems, offer potential benefits such as improved efficiency, cost reduction, enhanced security and reduced corruption risks compared to physical cash transfers. However, it is important to acknowledge that the inclusivity of digital solutions may be limited, especially for vulnerable populations such as refugees or internally displaced persons. The Better Than Cash Alliance highlights various challenges that hinder the inclusion of digital payments for these groups, including insufficient identification, regulatory barriers to

financial inclusion, limited mobile connectivity and electricity access, restricted device ownership and a lack of accessible merchants, banking agents, or automated teller machines (ATMs) for cash withdrawal (Better Than Cash Alliance, 2021). Overcoming these obstacles is crucial to ensure equitable access to humanitarian aid.

Digital tools have been leveraged in humanitarian crises to enhance inclusion. However, it is recognized that a combination of digital and in-person approaches is necessary to mitigate the exclusions that may arise from relying solely on digital tools (Bryant, 2022). Thus, a comprehensive approach that incorporates diverse delivery methods is essential to ensure effective and inclusive aid.

During the pandemic, humanitarian organizations have increasingly adopted biometric verification, social media analytics and satellite mapping to streamline aid delivery and to reduce costs. However, there have been concerns raised regarding the exclusion of individuals who are not active on social media, the neglect of specific needs of certain groups such as women and persons with limited mobility or visual impairments, and the potential compromise of privacy and security for refugee populations (Bryant, 2022). It is important to involve affected individuals in the design and ideation phases of digital systems in the humanitarian sector to ensure their needs and preferences are considered and to address potential unintended consequences.

It is important to involve affected individuals in the design and ideation phases of digital systems.

In summary, while digital solutions offer opportunities for improving humanitarian aid delivery, it is essential to address challenges related to inclusivity, privacy and accountability. By adopting collaborative and participatory approaches and considering a mix of digital and in-person methods, the humanitarian sector can strive to ensure that digitalization efforts align with the needs and rights of those in need.

1.3 Digitalization of education

Levels of education impact smallholder earnings and their likelihoods of adopting technology. As mentioned by the World Bank (2019a), better-educated farmers are more likely to engage in digital agriculture than farmers with lower levels of education. They are also more likely to have improved outcomes (such as output or productivity); for example, because of their enhanced ability to combine inputs effectively on larger plots of land (Ninh, 2020), or because of their greater propensity for adopting modern crop varieties (Paltasingh and Goyari, 2018). Returns to education are especially high for female smallholder farmers, for whom each additional year of schooling can add between 2 to 15 percent in agricultural gains (Lattanzio, Maroun and Rewald, 2017).

Moreover, increasing women's educational attainment benefits everyone's food security. Improvements in women's education were responsible for 43 percent of the total reduction of hunger in developing countries between 1970 and 1995 (Smith and Haddad, 2001).

The shift to remote learning during the pandemic had a significant impact on children and youth, disrupting their access to education and learning outcomes in ways that will have implications decades later on poverty reduction and food security. Remote education was widely seen as the way to limit pandemic-induced learning disruptions, with 186 countries introducing remote learning programmes during the onset of the pandemic (World Bank, UNESCO and UNICEF, 2021). However, access to remote education, specifically online education, was unequal.

World Bank, UNESCO and UNICEF (2021) found significant remote learning exclusion disparities between and within countries. "Globally, at least 463 million children could not be reached by digital and broadcast remote learning programmes amidst school closures, with three out of four unreached students coming from rural areas and/or poor households" (World Bank, UNESCO and UNICEF, 2021, p. 22). Moreover, LDCs were home to a disproportionate share of students who could not be reached through remote learning. Even when education was offered through broadcast media, children living in rural areas were still significantly less likely to own televisions and have access to the electricity necessary to access educational content. For example, only 26 percent of rural households in West and Central Africa owned televisions compared to 73 percent of urban households (World Bank, UNESCO and UNICEF, 2021; UNICEF, 2021a).

Pre-COVID-19, students in rural areas were already disadvantaged by schools with less digital equipment, internet access, and teachers who were lacking preparation to use ICT in teaching (OECD, 2022). Disparities in remote learning access and preparedness led to uneven learning losses across and within countries. Students from LICs, LMICs, rural areas, and disadvantaged areas experienced greater learning losses (World Bank, UNESCO and UNICEF, 2021). For example, Ethiopia developed a primary school distance learning programme in March 2020 using a mix of remote learning channels including TV, radio, and digital platforms (Sewunet, 2020). Once schools reopened in October 2020, children from rural and urban areas returned to school at a similar rate, but the learning gap between primary school students from rural and urban areas widened, with students from rural areas experiencing greater learning losses (Kim *et al.*, 2021).

BOX 5

AYA platform offers youth smallholders networking opportunities and training on how to leverage social media

The AYA (African Youth Agripreneurs) platform provides networking opportunities, knowledge sharing and peer-learning opportunities for young agripreneurs and rural youth organizations across Africa. The platform has seen significant growth, with a membership of 3 213 youth, including approximately 40 percent women, from all African countries. Since July 2022, the platform has experienced a monthly growth rate of 28.6 percent.

One of the key focuses of the AYA platform is to develop the digital skills of rural youth and young agripreneurs at various levels, including basic, intermediate and advanced skills. Through the AYA ambassadors' programme, FAO has trained 24 African youth in digital storytelling, content creation and

online community management. These ambassadors are intended to become community leaders within agrifood systems.

In collaboration with WYLDE International and Meta Inc (formerly Facebook), FAO has provided training sessions for 210 youth on how to grow a business using social media platforms such as Facebook, Instagram and WhatsApp. Additionally, FAO partnered with the Africa Women Agribusiness Network (AWAN Afrika) to deliver agribusiness training to approximately 80 young women from Kenya, Rwanda and Uganda. This training utilized a hybrid format, combining face-to-face and online sessions, facilitated through the AYA platform.

Remote learning was found to be especially disadvantageous for rural youth from marginalized backgrounds. Remote learning also widened learning gaps between wealth groups, between boys and girls, and between able-bodied children and children living with disabilities (Ahlgren *et al.*, 2022; Human Rights Watch, 2021). Students attending private schools and students from better-off socioeconomic backgrounds were more likely to benefit from family members with higher levels of education who were able to aid their learning efforts (Goudeau *et al.*, 2021; World Bank, UNESCO and UNICEF, 2021). Students attending schools predominantly serving students from marginalized backgrounds also experienced disproportionate learning losses (World Bank, UNESCO and UNICEF, 2021). Although schools have reopened, unequal remote learning access could disadvantage rural children again in the future. UNICEF (2021b) found that about half of LICs and LMICs are unprepared to deliver learning remotely during future emergency school closures.



Sri Lanka

In Mahailuppallama, FAO team introduced the new Fall Armyworm Monitoring and Early Warning System (FAMEWS) mobile application to farmers.

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2 THE DIGITAL DIVIDE IN RURAL CONTEXTS AND ITS CHARACTERISTICS

DIGITAL DIVIDE:

binary gaps in access or ownership of a specific technology or infrastructure (Helsper, 2021), also known as “basic access” (A4AI, 2022). The digital divide as traditionally defined is mainly captured in the first-level digital divide under the three levels of the digital divide framework.

DIGITAL INEQUALITY:

differences in usage patterns and abilities to make use of digital technologies including after-access barriers (Helsper, 2021; Hernandez and Faith, 2022). Digital inequalities are mainly captured in the second- and third-level digital divides under the three levels of the digital divide framework.

DIGITAL INCLUSION/

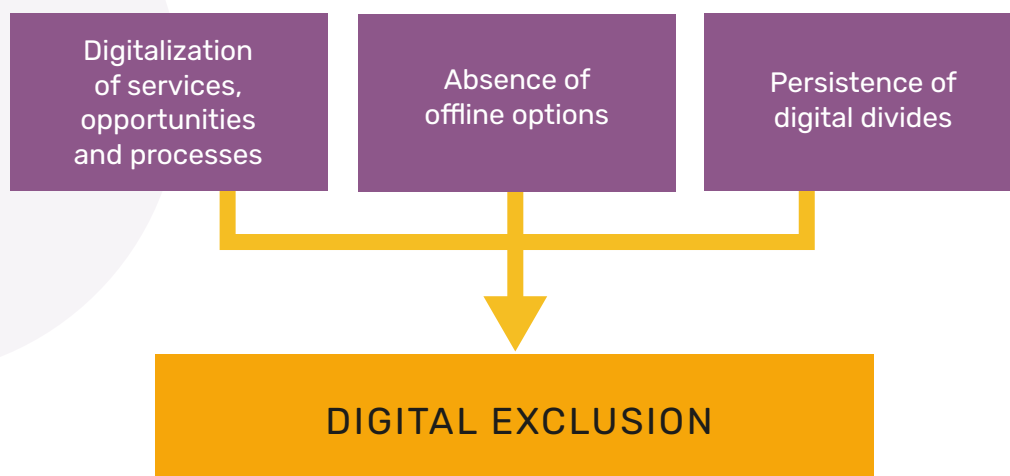
EXCLUSION: whether an individual has the sufficient amount of digital access, skills, and quality of access required to fully participate in society (Martin, Hope and Zubairi, 2016; Schejter *et al.*, 2015; Warren, 2007).

THIS SECTION PROVIDES A DEEP DIVE INTO THE MECHANISMS through which digital disparities in access and outcomes manifest themselves in rural contexts in the form of the three levels of the digital divide. While the terms “digital divide,” “digital inequality,” and “digital exclusion” are often used interchangeably, it is important to differentiate between these concepts as they encompass distinct dynamics (see definitions on the left).

While digital divide, inequality and exclusion are interconnected, it is important to note that being affected by one does not necessarily imply being affected by all three. Individuals may experience different levels of digital disparities depending on their specific circumstances.

For instance, someone may not encounter first-level digital divides if they have access to technology but may still face digital inequality if they have limited opportunities to utilize it effectively. On the other hand, non-users may experience digital divides but not be digitally excluded, as exclusion arises when lack of access prevents meaningful participation.

As highlighted in the introduction, digital inclusion is influenced by three key factors: the extent of digitalization in sectors relevant to the well-being of rural populations, the availability of offline alternatives to access services and opportunities in those sectors, and the presence of digital divides. The level of access, skills, and quality of technology required for full participation in society varies based on the specific context and evolves over time.

FIGURE 6**The three factors that lead to digital exclusion when combined**

Source: Authors' own elaboration

As sectors within societies increasingly undergo digitalization and offline options diminish, individuals face growing expectations to engage with technology. However, this process is not always linear, as digital solutions can encounter setbacks, and citizens may resist digitalization processes that they perceive as disempowering (Kuntsman and Miyake, 2022).

To understand the risk of digital exclusion faced by rural populations in deprived rural areas, delving deeper into the access and after-access barriers they encounter is essential. Extensive research spanning over 25 years has demonstrated that digital exclusion arises not only from digital divides but also from digital inequalities, which are multidimensional and dynamic (Heeks, 2022; Ragnedda and Ruiu, 2017; Schradie, 2011; van Deursen and Helsper, 2015). One widely recognized conceptual framework for understanding digital inequalities is the “three levels of digital divide” typology (Ragnedda and Ruiu, 2017; van Deursen and Helsper, 2015).

This section contextualizes digital divides in rural areas of LICs and LMICs, focusing on the experiences of rural women when data is available. While some official surveys may cover elements and aspects that cut across multiple levels, there is a prevailing tendency among development organizations to primarily focus on the first level of the digital divide, with limited emphasis on the second level (e.g. digital skills). This includes country-level surveys conducted by governments, which often measure certain elements of the second-level digital divide, such as frequency of use, but fail to fully consider the barriers that users may encounter once they are online, which can restrict further usage (Hernandez and Faith, 2022).

FIGURE 7
The three levels of the digital divide

DIGITAL DIVIDE

FIRST LEVEL

Basic access/ binary gaps

- Gaps in usage
- Gaps in ownership
- Barriers to gaining access (e.g. awareness, affordability, basic infrastructure, electricity, identification, etc.)

SECOND LEVEL

Quality of access/ after-access barriers

- Usage patterns
- Speed
- (Un)limited data
- Continuous access
- Skills
- User autonomy
- Reliance on others
- Device quality
- Safety and security

THIRD LEVEL

Structural inequalities (root causes) leading to uneven gains

- Economic resources
- Human capital
- Social capital
- Social norms
- Civic and political influence
- Local institutional capacity
- Functioning of local markets
- Representation

Source: Authors' own elaboration

To effectively address digital exclusion in rural areas and confront the spatial inequalities that digitalization may exacerbate, development actors must begin to address elements from the second and third levels of the digital divide. Currently, data often lacks disaggregation by rurality or gender, and there is a lack of data for other marginalized rural groups, such as young people, persons with disabilities, Indigenous Peoples, older persons, migrants, displaced people, and community/local organizations.

It is crucial to develop surveys that comprehensively account for the second- and third-level digital divides and ensure disaggregated data is available to capture the experiences of marginalized rural groups. Furthermore, data that further disaggregates rural regions beyond the simple urban vs rural binary is also limited. For instance, data on rural areas is rarely broken down according to the “development domain,” which considers factors such as agricultural potential, access to markets, and population density in distinguishing between rural areas and shaping their development trajectories (Abay *et al.*, 2020; Chamberlin, Pender and Yu, 2006).

2.1 Gaps in access to digital technology

The first level of the digital divide focuses on the disparities between individuals with access to digital technology and those without access. Official surveys, such as those conducted by the ITU and national surveys, primarily measure the first-level digital divide by examining the binary difference between internet users and non-users. These surveys typically ask whether individuals have used the internet in the past three months or whether they own specific digital devices or connectivity subscriptions. The metrics used for device ownership or specific internet activities, such as social media usage, are also often measured.

However, relying solely on this binary distinction is insufficient to gauge the risk of digital exclusion. Once individuals are online, they may still encounter after-access barriers that hinder their continuous and autonomous use of the internet. Therefore, it is essential to consider the second- and third-level digital divides to fully understand the extent of digital exclusion.

Relying solely on data on binary gaps in access is insufficient to gauge the risk of digital exclusion.

For example, when the ITU reports that residents in rural areas are only half as likely to be online compared to their urban counterparts or that men in LDCs are more likely to be online than women, they are referring to the first-level digital divide (ITU, 2021a). These disparities are well-documented across various aspects of digital connectivity infrastructure, devices and digital activities between urban and rural areas.

The following subsections will summarize the available data and evidence on the first-level digital divide, including the barriers commonly associated with it.

2.1.1 Gaps in basic internet usage

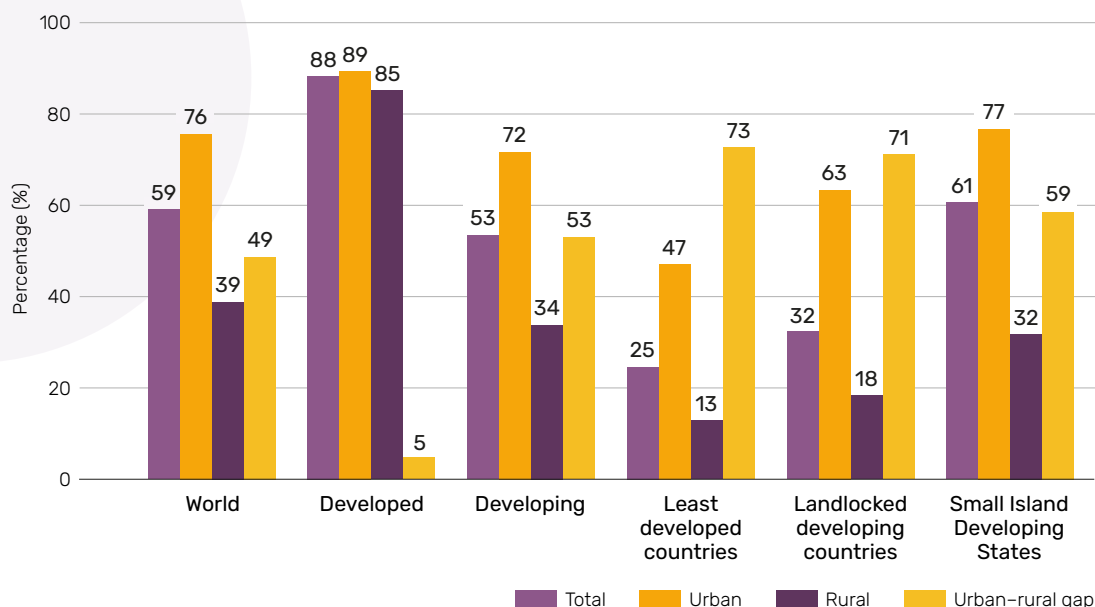
According to the ITUs “Internet use estimates” dataset, which is the only publicly available internationally comparable dataset on ICT use in urban and rural areas, 59.1 percent of individuals worldwide used the internet at least once in the last three months leading up to the survey conducted in 2020 (ITU, 2021b). The data reveals significant disparities in basic internet access between regions and urban and rural areas. In general, rural residents had about half the likelihood of having basic internet access compared to urban residents (see Figure 8 below).

The extent of this divide varies across regions and country income levels. While the gap between urban and rural residents in developed countries is relatively small, with urban residents only slightly more likely to be online, the gap is much wider in developing countries, where urban residents are more than twice as likely to have basic internet access compared to rural residents. The divide is even more pronounced in LDCs, where urban residents are over four times as likely to have used the internet compared to rural residents.

Similar disparities are observed in Small Island Developing States (SIDS), Africa, Asia-Pacific, and Arab States¹¹ (see Figure 9 below).

FIGURE 8

Percentage of individuals using the internet at least once in the last three months, by urban-rural area in each geographic region in 2020



Note: The urban rural gap was arrived at using the following formula:
 $1 - (\text{rural internet users} / \text{urban internet users})$

Source: ITU. 2021. Statistics. In: *ITU*. Geneva, Switzerland. [Cited 28 March 2024].
<https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

FIGURE 9

Percentage of individuals using the internet, by urban-rural area in each geographic region in 2020



Note: CIS - Commonwealth of Independent States

Source: ITU. 2021. Statistics. In: *ITU*. Geneva, Switzerland. [Cited 28 March 2024].

¹¹ The term 'Arab States' refers to the classification in ITU. 2024. Economy classifications. In: *ITU*. Geneva, Switzerland. [Cited 3 April 2024]. <https://www.itu.int/en/ITU-D/Statistics/Pages/definitions/regions.aspx>

<https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

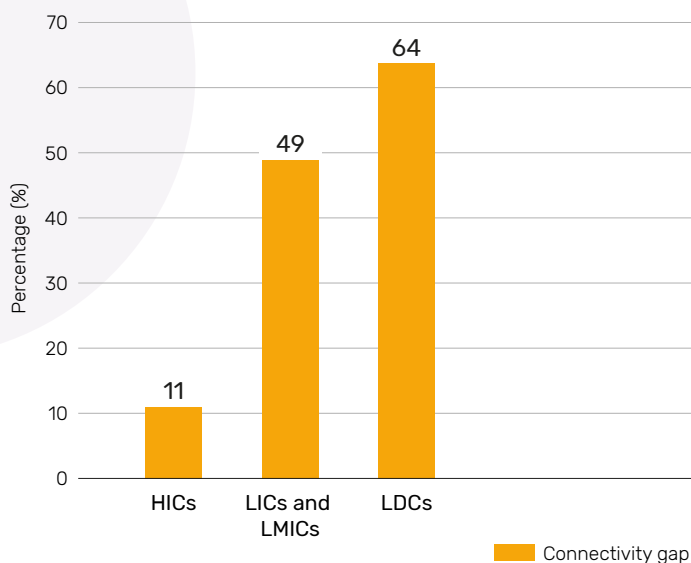
The ITU also provides access data disaggregated by sex, but this information is available only for 118 countries. Among these countries, only 22 have provided intersectional data on sex and rurality. These 22 countries include 2 LICs (Mozambique and Ethiopia) and 11 LMICs (Algeria, Bhutan, the Plurinational State of Bolivia, Cabo Verde, Côte d'Ivoire, Egypt, El Salvador, Honduras, Palestine, Ukraine, Uzbekistan and Zimbabwe). Across these 13 LICs and LMICs, urban residents were more than twice as likely to have basic internet access compared to rural residents (ITU, 2021b).

While there are significant gaps between urban men and women and rural men and women, the disparities are smaller compared to the gaps between people living in urban and rural areas. Urban women were nearly three times as likely to have basic internet access compared to rural women and urban men were more than twice as likely to have basic access compared to men living in rural areas. The largest gap in the analysed countries exists between urban men and rural women, highlighting the presence of a “triple divide” encountered by women (FAO, 2018a). Therefore, rural women experience intersectional disadvantages in accessing basic internet services, as they face lower overall access rates in rural areas, and gender gaps are more pronounced in rural settings.

While there is publicly available data on youth with basic internet access (having used the internet at least once in the past three months), there is a lack of similar data for other age groups, including older people. The ITU provides data tables comparing the percentage of youth classified as internet users compared to the rest of the population. However, this data includes countries with varying definitions of youth, making it unreliable for comparing basic internet usage across countries, regions and income groups. Different countries have different age ranges for defining youth, such as ages 1 to 25 or beginning at ages 5, 15, etc. Additionally, some countries set the upper age limit for “youth” at, before or after 25. The ITU's youth data also lacks further disaggregation by gender or region type. Furthermore, the ITU does not provide age-specific data beyond the categorization of “youth” and the rest of the population, resulting in a gap in understanding basic internet access for older people.

The ITU does not disaggregate its data by poverty level or within-country income distribution. However, an analysis conducted by GSMA reveals that the basic internet access gap between the richest and poorest 20 percent of the population is significantly wider in LICs, LMICs and LDCs compared to HICs (GSMA, 2022a).

FIGURE 10

Binary access gap between the poorest and richest 20 percent across country income groups

Note: HICs - high-income countries; LICs - low-income countries; LMICs - lower middle-income countries; LDCs - least developed countries

Source: GSMA. 2022. *The State of Mobile Internet Connectivity 2022*. London. <https://tinyurl.com/3uf7vxfe>

In addition to the limited data availability on regions, gender and unreliable youth data, there is a lack of publicly available internationally comparable data disaggregated by other dimensions of marginalization. This creates significant gaps in understanding the digital access levels of Indigenous Peoples, ethnic and racial minorities, migrants, people living in poverty, people living with disabilities and other marginalized groups. Policymakers and programme designers face challenges in addressing the digital divide without comprehensive and comparable data on these groups, intersecting various dimensions of marginalization.

There are significant data gaps regarding digital access levels of Indigenous Peoples, ethnic and racial minorities, migrants, people living in poverty, people living with disabilities and other marginalized groups.

Furthermore, current internationally comparable statistics on digital access tend to be binary in nature, even when disaggregated by demographic groups or areas. These statistics classify anyone as an internet user if they have used the internet at least once in the past three months. As a result, the ITU's 'internet user' metric provides only a limited perspective on the first-level digital divide. There is a clear need for internationally comparable statistics that capture the nuances of the second and third-level digital divides discussed in Sections 2.2 and 2.3.

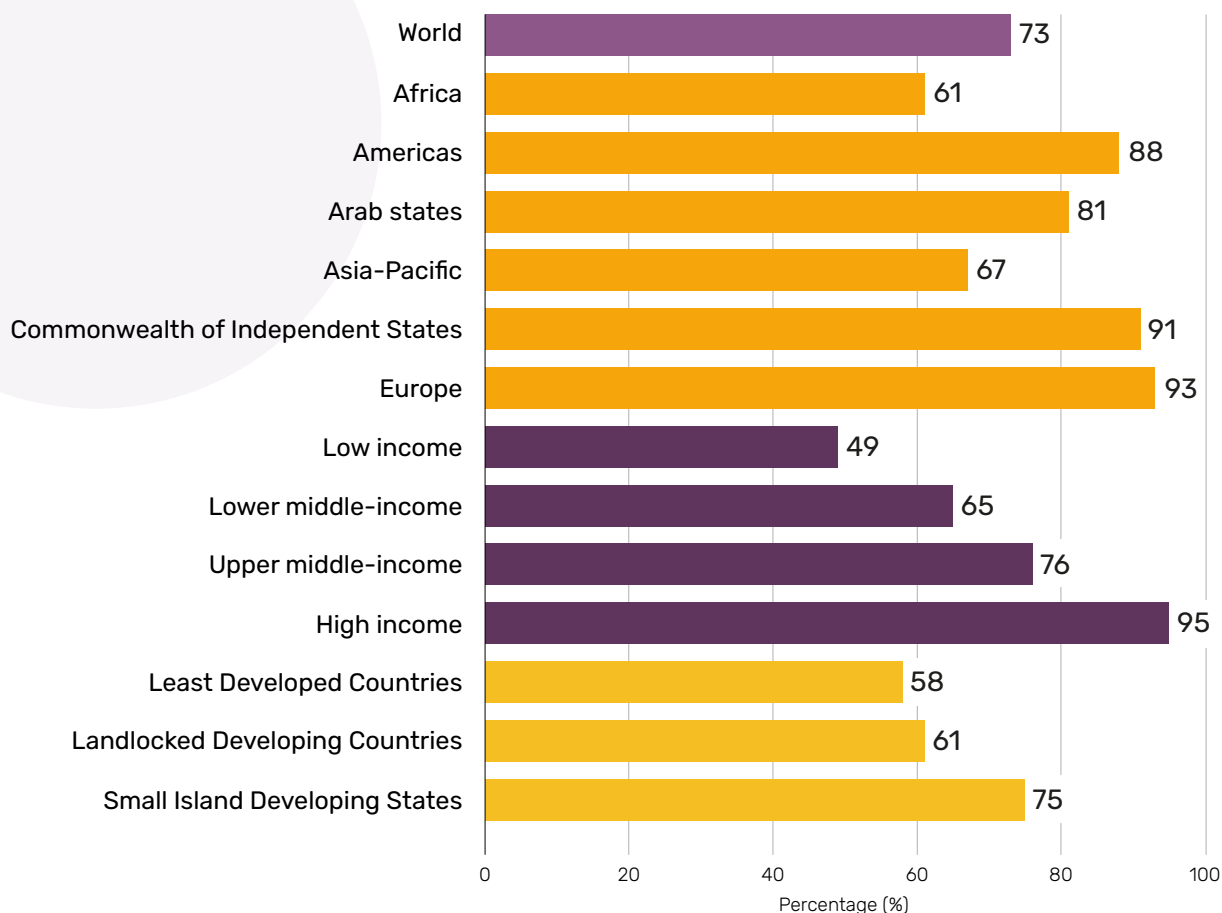
2.1.2 Binary gaps in device ownership and app usage

In addition to disparities in internet usage, digital divides also exist in terms of mobile phone access and ownership, as well as access to other digital devices and specific applications. Rural dwellers, in particular women and other marginalized groups, often face barriers to accessing and owning mobile phones and specific digital devices and applications. For example, women are 7 percent less likely to own a mobile phone and 18 percent less likely to own a smartphone compared to men (GSMA, 2022b). There are notable variations in mobile ownership across regions, with residents in LDCs, LICs, and LMICs being less likely to own mobile phones compared to the global average (see Figure 11 below). Although there is a lack of internationally comparable data specifically disaggregated by type of region, studies conducted across different countries indicate that rural residents are generally less likely to own mobile phones and smartphones compared to their urban counterparts (Kronke, 2020).

Furthermore, digital divides are evident in the usage of specific applications. A study by Tsan *et al.* (2019) revealed that women constitute only 25 percent of African digital agriculture users,

FIGURE 11

Percentage of individuals owning a mobile phone



Source: ITU. 2022. Facts and Figures 2022. In: *ITU*. Geneva, Switzerland. [Cited 28 March 2024]. <https://www.itu.int/itu-d/reports/statistics/facts-figures-2022/index/>

despite accounting for 40–50 percent of smallholder farmers on the continent. There is also a disparity in mobile money account ownership, particularly among rural residents, with rural women facing additional challenges due to a gender gap in account ownership (GSMA, 2022c). The gender gap in mobile money ownership tends to be more pronounced in rural areas.

Disaggregated data on the first-level digital divide can shed light on how intersecting inequalities can further disadvantage certain groups whose struggles may otherwise go unnoticed. For instance, in Indonesia, overall ownership of mobile money accounts may appear to be equal between men and women at the country level. However, when examined at the rural level, it becomes evident that rural men are significantly more likely to own a mobile money account compared to rural women (see Table 4 below).

TABLE 4

Mobile money account ownership gaps entire country vs rural areas

COUNTRY	COUNTRY-LEVEL GENDER GAP	RURAL GENDER GAP
Egypt	35%	54%
Kenya	7%	7%
Nigeria	46%	71%
Senegal	14%	18%
Bangladesh	52%	54%
India	68%	78%
Indonesia	-1%	33%
Pakistan	71%	70%

Source: GSMA. 2022. *The State of Mobile Internet Connectivity 2022*. London.
<https://tinyurl.com/3uf7vxfe>

2.1.3 Binary gaps in network coverage

Statistics also highlight disparities in the availability of digital infrastructure. According to the ITU, 97 percent of the global population is covered by a mobile signal, with 100 percent coverage in urban areas compared to 93 percent in rural areas (ITU, 2021a). However, the availability of mobile signals is not uniform, and rural areas in developing countries have lower coverage compared to rural areas in developed countries. In particular, rural areas in LDCs and SIDS are especially less likely to be covered by a mobile signal. It is important to note that coverage by a mobile signal includes 2G signals, which may not be sufficient for certain digital

applications. Furthermore, these disparities are more evident for newer and faster mobile infrastructure such as 4G and 5G (refer to Section 2.2.2 for more details).

The existence of such divides can be attributed to the fact that digital infrastructure deployment is typically driven by private telecommunications companies, who prioritize serving profitable and easily accessible markets (Tsan *et al.*, 2019; United Nations, 2022; United Nations Secretary-General, 2020b). Rural and remote areas, particularly those that are more deprived and have lower purchasing power and population densities, are often considered unprofitable and thus less likely to be served by digital infrastructure or tend to receive it at a later stage compared to more affluent areas (Aldashev and Batkeyev, 2021; Prieger, 2003; Trendov, Varas and Zeng, 2019a).

In countries where telecommunications infrastructure deployment is mainly undertaken by state-owned enterprises, governments may practise “ethnic favouritism,” prioritizing areas where politically influential ethnic groups reside while excluding minority groups strategically. This is driven by concerns that increased internet access for politically marginalized groups could lead to political mobilization or civil unrest (United Nations, 2022; Weidmann *et al.*, 2016). As a result, rural areas with a high concentration of racial, religious and ethnic minorities and Indigenous Peoples may experience deliberate digital exclusion.

TABLE 5
Population covered by a mobile signal (at least 2G) in 2021
disaggregated by type of region

COUNTRY INCOME GROUP	URBAN	RURAL
World	100%	93%
Developed	100%	98.6%
Developing	100%	92.5%
Least developed countries	100%	84.8%
Land locked developing countries	100%	91.2%
Small Island Developing States	99.9%	76.9%

Source: ITU. 2022. Facts and Figures 2022. In: *ITU*. Geneva, Switzerland. [Cited 28 March 2024].
<https://www.itu.int/itu-d/reports/statistics/facts-figures-2022/index/>

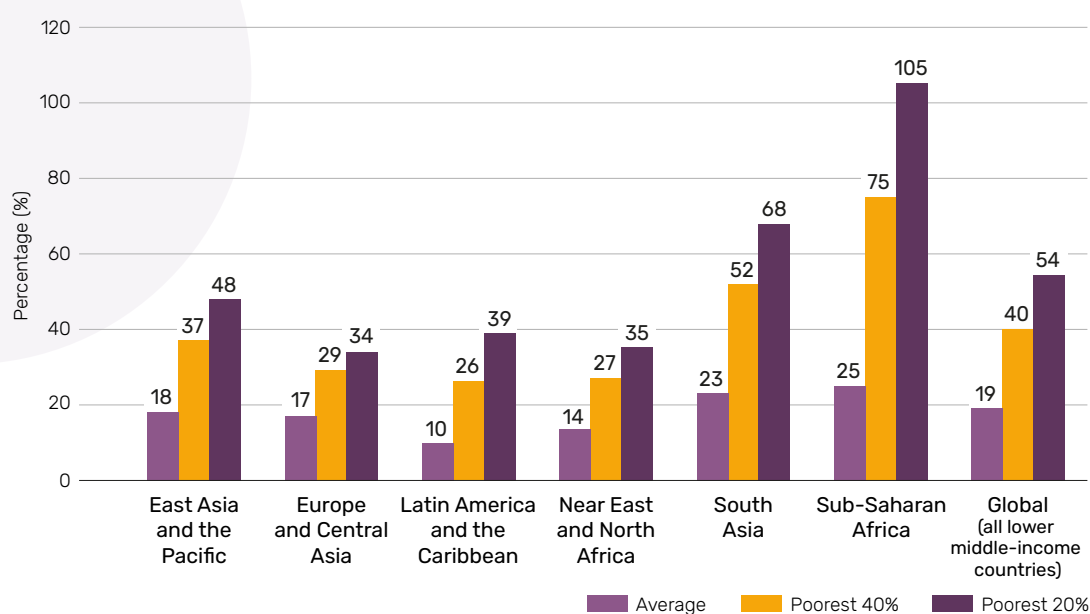
2.1.4 Barriers to gaining basic access

The first-level digital divide encompasses barriers to usage, including cost and affordability, awareness, lack of locally relevant content and motivational factors (GSMA, 2016a). While awareness of the internet is relatively high in most countries, it remains a significant barrier to mobile internet usage. In India and Bangladesh, only 60 percent and 70 percent of the populations were aware of the internet in 2021, despite the pace of digitalization during the pandemic (GSMA, 2022a).

Affordability of handsets and mobile data is a major hindrance to internet adoption. The median cost of an entry-level internet-enabled device averaged 19 percent of monthly gross domestic product (GDP) per capita across LMICs in 2021, with higher costs in SSA and South Asia (GSMA, 2022a). In SSA, the cost of an entry-level internet-enabled device exceeds the average monthly income of the poorest 20 percent of the population. Similarly, the cost of 1 gigabit of data amounts to an average of 1.7 percent of monthly GDP per capita in LICs and LMICs, but is significantly higher in Africa (GSMA, 2022a).

FIGURE 12

Price of an entry-level internet-enabled device (might not be a smartphone) in 2021 as a percentage of GDP per capita by income distribution

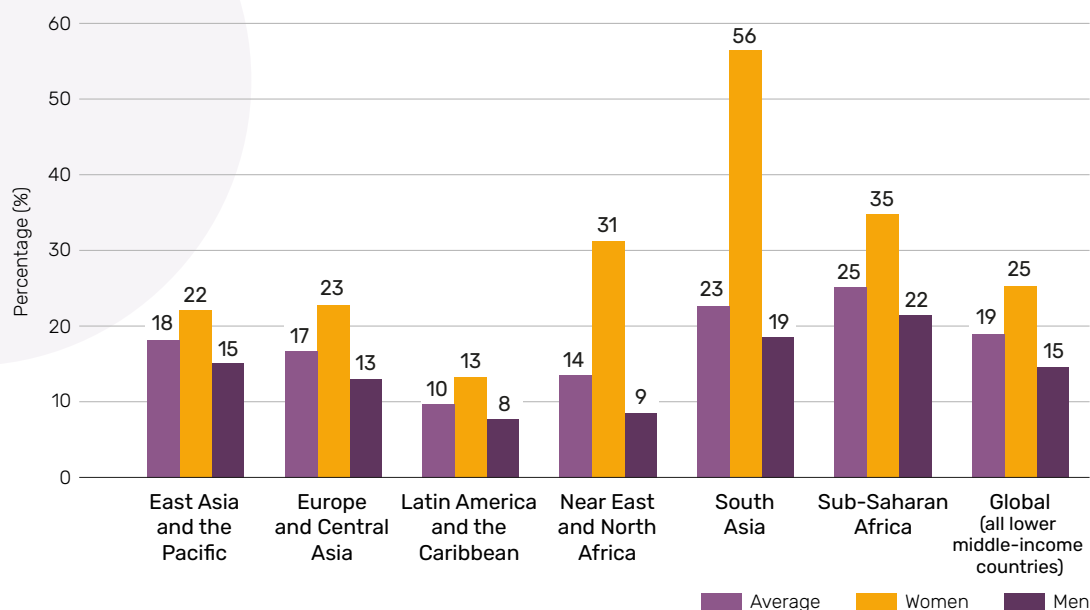


Source: GSMA. 2022. *The State of Mobile Internet Connectivity 2022*. London.
<https://tinyurl.com/3uf7vxfe>

Handsets and data are particularly unaffordable for the poor and for women. It is worth noting that the GSMA's definition of "entry-level internet-enabled devices" includes feature phones and some low-cost smartphones, which may not provide a satisfactory internet experience, as further discussed in Sections 2.3.8 and 2.3.9.

FIGURE 13

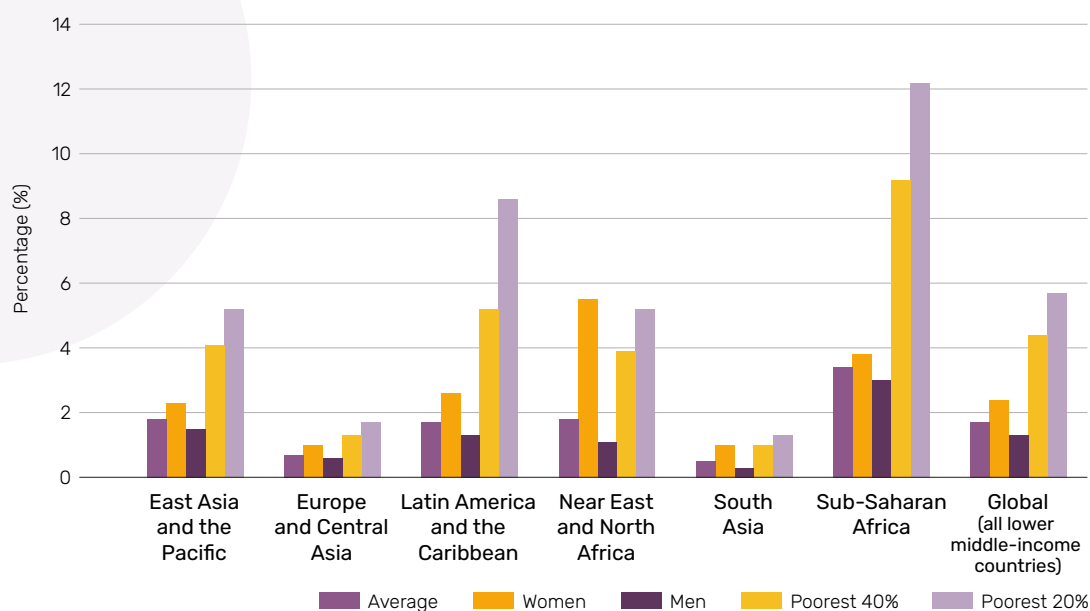
Price of an entry-level internet-enabled device (might not be smartphone) in 2021 as a percentage of GDP per capita by sex



Source: GSMA. 2022. *The State of Mobile Internet Connectivity 2022*. London.
<https://tinyurl.com/3uf7vxfe>

FIGURE 14

Price of 1 GB of data in 2021 as a percentage of GDP per capita by sex and income

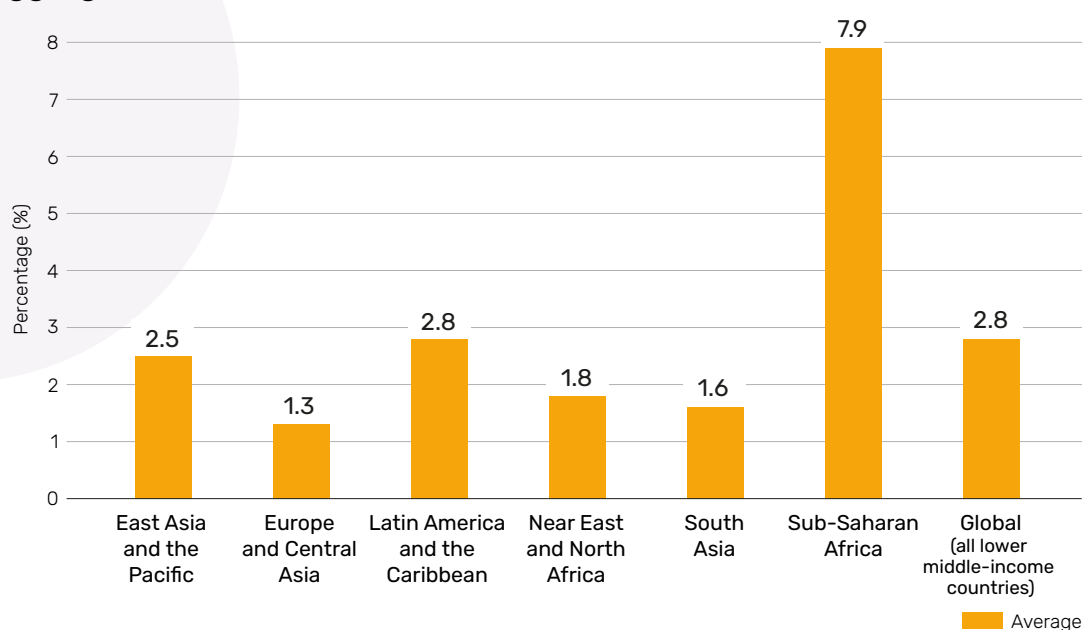


Source: GSMA. 2022. *The State of Mobile Internet Connectivity 2022*. London.
<https://tinyurl.com/3uf7vxfe>

Affordability issues disproportionately affect people living in rural areas, considering that over 80 percent of those living in extreme income poverty and 75 percent of those in moderate poverty reside in rural areas (Castaneda *et al.*, 2016). Limited resources often lead individuals to rely on prepaid options, which are more expensive than post-paid connectivity in the long run (Isenberg, 2019). It is worth noting that while the GSMA provides affordability data for 1 gigabyte (GB) of data, it does not disaggregate affordability for larger quantities of data (e.g. 5 GB or unlimited data), which as shown in Section 2.2.3, would offer users better quality digital experiences.

FIGURE 15

**Average price of 5 GB of data as a percentage of GDP per capita
(further disaggregation not made available)**



Source: GSMA. 2022. *The State of Mobile Internet Connectivity 2022*. London.
<https://tinyurl.com/3uf7vxfe>

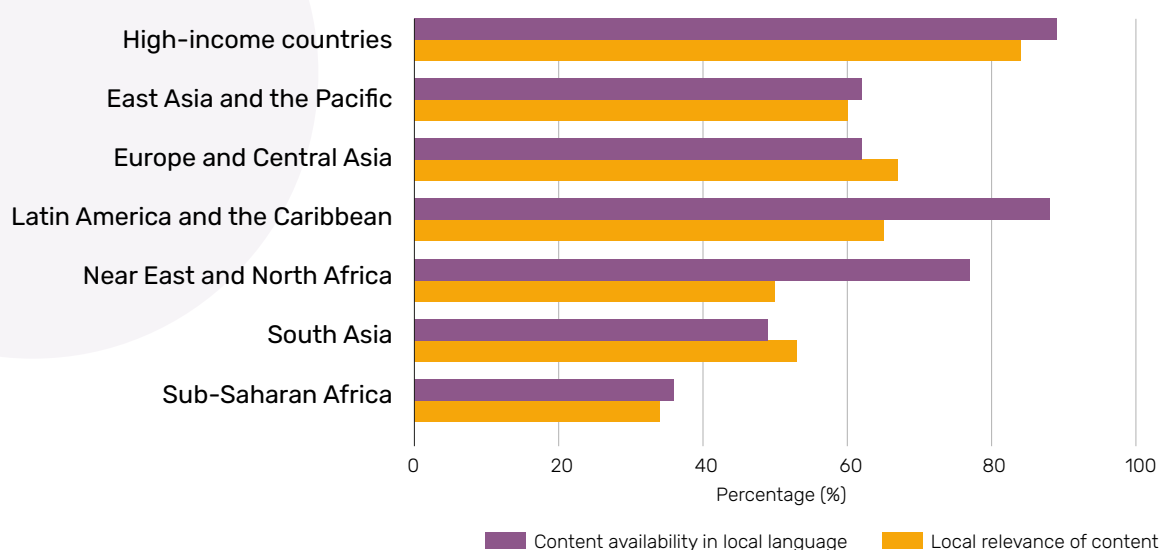
Safety and security concerns are significant barriers that can lead non-users to self-exclude from using the internet, due to fears of harassment, fraud, online theft, and data insecurity (GSMA, 2022a). According to the GSMA, the number of non-users citing safety and security concerns as a barrier to adoption has been increasing in many countries, with over 70 percent of non-users in Mexico and Guatemala affected by this barrier. The lack of relevant digital content, services, and products that meet their interests or needs is another reason why some individuals choose not to use the internet (GSMA, 2022a).

Furthermore, language and content accessibility pose challenges to digital inclusion. As of December 2022, 58.6 percent of internet content is in English, and the top 10 languages (sorted by percentage from largest to smallest: Russian 5.3 percent, Spanish 4.4 percent, French 3.8 percent, German 3.7 percent, Japanese 3.1 percent, Turkish 2.7 percent, Persian 2.3 percent, Chinese 1.6 percent, Italian 1.6 percent) account for nearly 90 percent of all content on the World Wide Web (W3Techs, 2022).

The GSMA's Mobile Connectivity Index measures the existence of locally relevant content and the availability of content in local national languages, among other indicators. The index reveals significant regional disparities, with HICs having more locally relevant content available in national languages compared to developing regions (GSMA, 2022b). It is important to note that language diversity within countries and the fact that some groups may not speak the dominant national language can further exacerbate the lack of locally relevant content, particularly impacting rural populations.

FIGURE 16

Average connectivity index score for local relevance and availability of content in local languages 2021



Source: GSMA, 2022. *The State of Mobile Internet Connectivity 2022*. London.
<https://tinyurl.com/3uf7vxfe>

Access to electricity is crucial for charging portable devices, powering Wi-Fi networks and using personal computers (PCs), all of which are essential for digital connectivity. However, rural areas in LICs and LMICs often have limited access to electricity (World Bank, 2022b). Certain regions, such as SSA, face significant challenges with 77 percent of people without access to electricity residing in this region, particularly in rural areas (UN Statistics Division, 2022). SSA and Oceania exhibit the lowest levels of rural electric connectivity globally (UN Statistics Division, 2022; World Bank, 2022b). It is important to note that access to electricity is not solely reliant on connection to the electrical grid; affordability

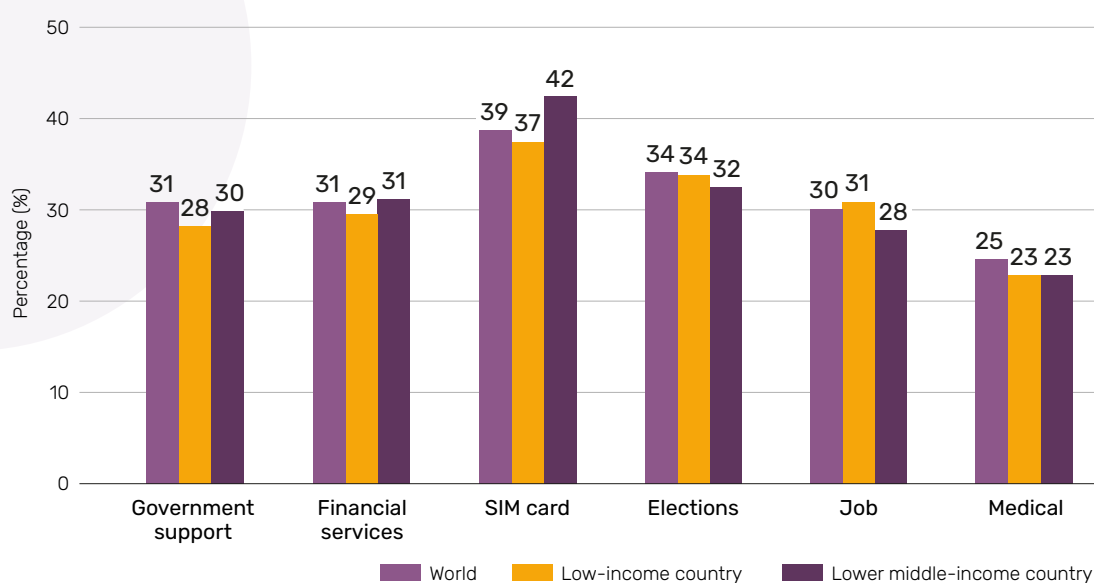
also plays a crucial role. Even when electricity is available, issues of affordability can hinder its uptake. Additionally, consistent power outages can make digital connectivity unreliable and unpredictable. While solar and other renewable energy sources exist, their availability and affordable financing mechanisms are not widely accessible in rural areas (World Bank, 2022c).

In many countries, obtaining a SIM card for mobile broadband access requires presenting official identification. Unfortunately, this practice creates a barrier that excludes a significant number of people. It is estimated that nearly 1 billion people lack identification, with the majority (90 percent) residing in LICs and LMICs (Clark, Metz and Casher, 2021; GSMA, 2021a). This disproportionately affects refugees, women, individuals in rural areas and other marginalized groups, as they are less likely to possess identification documents (Privacy International, 2021a).

For those without identification, registering a SIM card becomes a significant challenge. In fact, individuals without identification have reported that obtaining a SIM card is more difficult than accessing government support or participating in elections (Clark, Metz and Casher, 2021). This issue not only excludes marginalized groups from digital connectivity but also infringes upon their rights. Furthermore, identification requirements can be manipulated by governments to intentionally exclude racial, ethnic and religious minorities. The governments of Myanmar and Bangladesh, for example, have utilized identification requirements as a means of keeping the Rohingya community offline due to their lack of identification documents (Chong, 2017; Privacy International, 2021b).

FIGURE 17

Percentage of people who lack identification experiencing difficulties accessing rights, services and opportunities in 2021

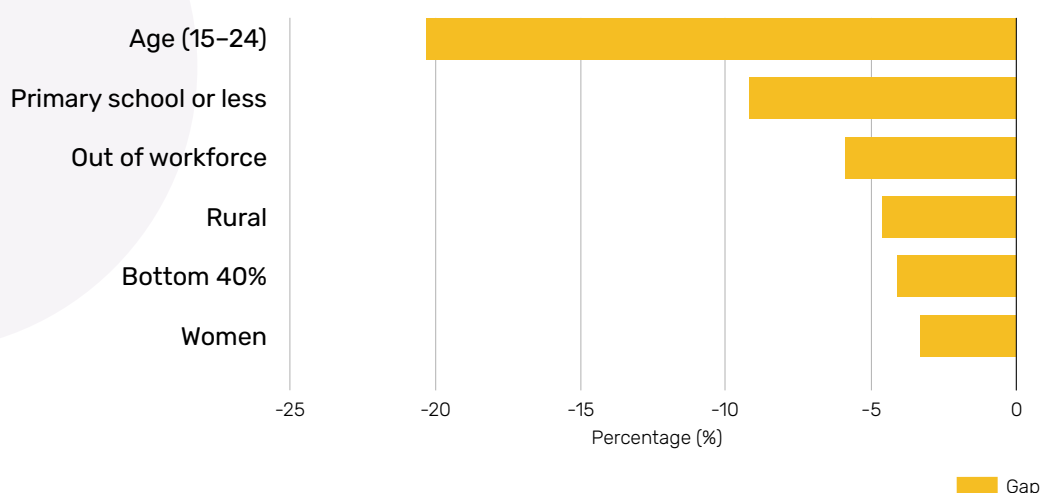


Source: Clark, J., Metz, A. & Casher, C. 2021. *ID4D Global Dataset 2021, Volume 1: Global ID coverage estimates*. Washington, DC, World Bank. <https://tinyurl.com/2wn5fz35>

Groups such as rural residents, women, youth, individuals with lower levels of education, and the unemployed are among those less likely to possess identification (Clark, Metz and Casher, 2021). While intersectional data is not readily available, it is reasonable to assume that individuals from rural areas who belong to multiple marginalized groups face even greater challenges in obtaining a SIM card due to the lack of identification.

FIGURE 18

Groups less likely to have identification documents in low-coverage countries (percent less likely than the rest of population, 2021)



Note: Groups are compared against the rest of the population as follows: women vs men; bottom 40 percent vs top 60 percent; rural vs urban; out of workforce vs in workforce; primary school or less vs more than primary school; 15-24 vs 25+.

Source: Clark, J., Metz, A. & Casher, C. 2021. *ID4D Global Dataset 2021, Volume 1: Global ID coverage estimates*. Washington, DC, World Bank. <https://tinyurl.com/2wn5fz35>

Women and other marginalized groups face additional barriers to connectivity, as documented by Delaporte (2021). In male-dominated societies, social norms can act as a significant barrier for women in rural areas, where it may be considered inappropriate for them to use or own mobile phones (APC, 2018). Women who defy these norms may face backlash in the form of gossip, cyberbullying, or even physical violence (Girl Effect, 2018; Hölzl, 2021). It is important to acknowledge that some individuals may choose to self-exclude from digital spaces due to personal preferences or disagreements with the prevailing private or geopolitical interests driving digitalization or simply because they prefer in-person interactions (Helsper, 2021; Lewis, 2017).

2.2 Going beyond binaries

The second-level digital divide goes beyond the binary distinction between digital technology users and non-users, taking into account the differences among those who have access. As societies increasingly rely on digital interactions for economic, social, political, and civic activities, understanding these differences becomes crucial (Helsper, 2021; Hernandez and Roberts, 2018). The COVID-19 pandemic and the subsequent lockdowns and social distancing measures have further emphasized the importance of considering factors beyond binary gaps. A notable example is the United Kingdom of Great Britain and Northern Ireland (United Kingdom), a highly digitalized society where 95 percent of the population are considered “internet users” (OFCOM, 2021). However, a significant portion of the population lacked access to internet speeds that were sufficient for seamless remote work or online learning (Global Wireless Solutions, 2020; Office for Students, 2020). This highlights how differences in quality and user capabilities within highly digitalized societies can lead to digital exclusion, despite the majority being classified as “internet users.” Policymakers, employers, and educational institutions could have anticipated these challenges by paying more attention to the after-access digital inequalities and barriers. Moreover, people living in rural areas, women and other marginalized groups are more likely to experience these barriers.

People living in rural areas, women and other marginalized groups are more likely to experience after-access barriers.

This subsection provides a glimpse into this issue, but further research is needed to comprehensively understand the factors that continue to hinder the empowerment of individuals in rural areas, even after gaining internet access. Societies undergoing rapid digitization can learn from the conceptual shortcomings observed during the COVID-19 pandemic in highly digitalized societies. By shifting focus from solely addressing binary digital gaps (first-level digital divide) to jointly addressing issues of quality, skills and autonomy from the outset, policymakers and organizations can better navigate potential exclusions that may arise from digitization.

2.2.1 Usage patterns

Once access to the internet is obtained, the frequency and range of activities that individuals engage in online can vary significantly. Merely having basic access to technology does not guarantee prolonged or effective use, and individuals from marginalized backgrounds tend to use digital technologies less frequently and for a limited number of activities compared to those from privileged backgrounds (Girl Effect, 2018; Gurstein, 2011; Schradie, 2011). In some countries, many smartphone owners, particularly women, do not use the internet (GSMA, 2022b). A study by FAO highlighted that even when women own phones, they use them less often

than men and access fewer services beyond voice communication (Isenberg, 2019). Limited users often develop a preference for essential activities, missing out on opportunities for learning, exploration, and creative use of technology (Girl Effect, 2018; Robinson, 2009).

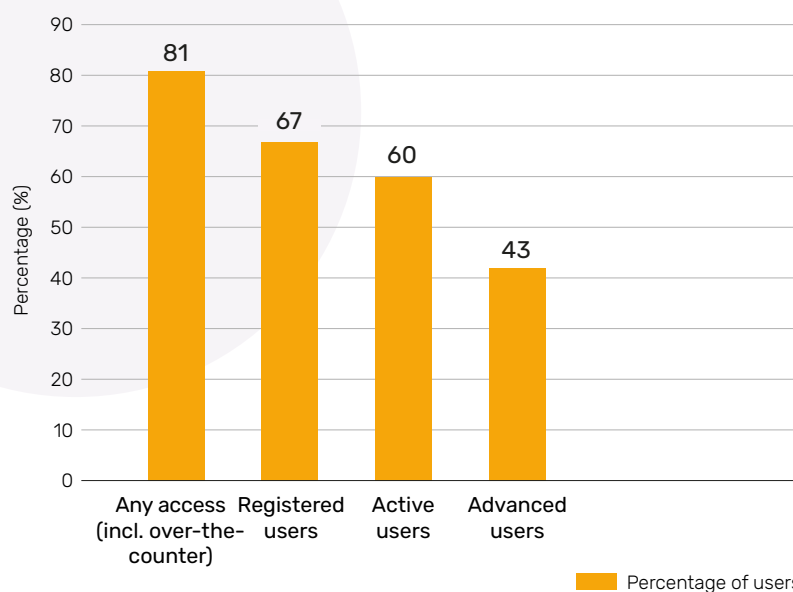
A study conducted by Girl Effect (2018) across 25 countries in Africa, Asia, Latin America, North America, and the Near East found that girls were more likely than boys to have access to mobile devices through borrowing rather than ownership. This discrepancy in ownership had significant implications for how boys and girls used phones, with boys engaging in a wider range of activities compared to girls. Similarly, GSMA (2021a) found an urban–rural gap in mobile phone activities. Rural residents with access were less likely to shop online, access health education or use digital financial services compared to their urban counterparts. Moreover, when rural users did engage in these activities, they did so less frequently than urban users (GSMA, 2021).

Research by Kronke (2020) in 34 African countries revealed that urban residents were more likely to use mobile phones and the internet on a regular basis compared to rural residents. The difference in usage frequency was significant, with 48 percent of urban residents reporting frequent usage compared to only 18 percent of rural residents.

Marginalized groups also tend to underutilize the features and opportunities offered by specific digital applications. In Kenya, for example, the percentage of people utilizing advanced mobile money features (such as saving, paying bills, receiving wages, and obtaining loans) was lower than the number of active users, which was itself lower than the number of registered users (See Figure 19 below). Rural residents, individuals below the poverty line, women, and those with primary education or lower were found to be less likely to be advanced users (InterMedia, 2016).

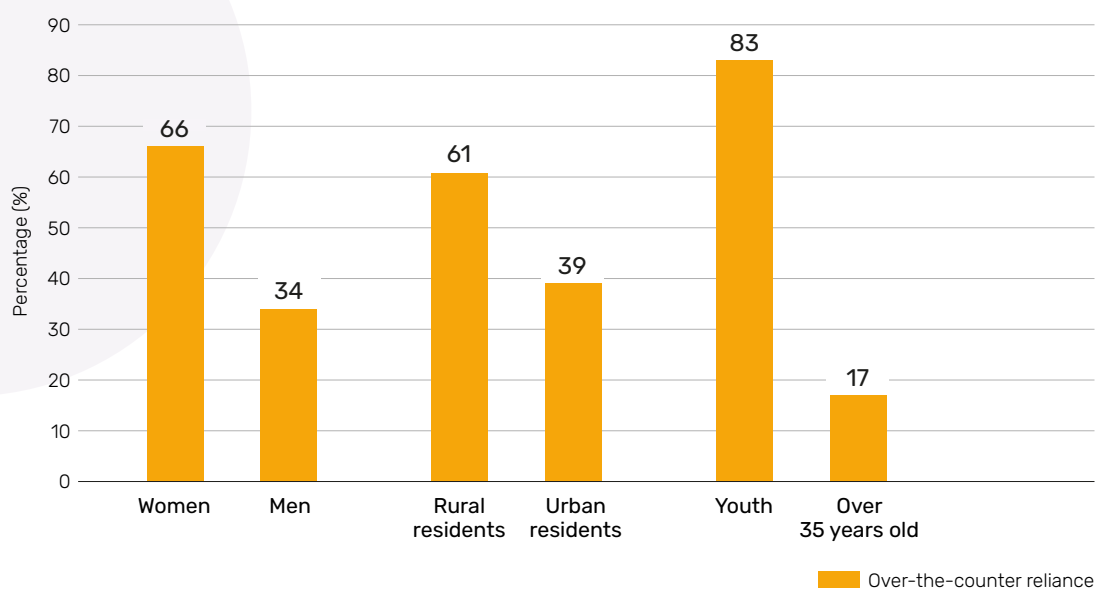
Mobile money users from marginalized backgrounds also relied more on accessing mobile money through someone else's account. In Kenya, women, rural residents, and youth were significantly more likely to rely on over-the-counter usage compared to men, urban residents and individuals above the age of 35. Unregistered mobile money users were predominantly rural residents, females, and those living below the poverty line (See Figure 20 below). On the other hand, active users (those who had used their account in the last 90 days) were more likely to be male, urban residents, employed, and living above the poverty line (InterMedia, 2016).

FIGURE 19

Mobile money users in Kenya by type of access, 2016

Source: InterMedia. 2016. *Kenya: Wave 4 Report FII Tracker Survey*. Financial Inclusion Insights. Washington, DC, InterMedia and Seattle, USA, Bill and Melinda Gates Foundation. <https://tinyurl.com/37frb3jr>

FIGURE 20

Over-the-counter mobile money users by key demographics in Kenya, 2016

Source: InterMedia. 2016. *Kenya: Wave 4 Report FII Tracker Survey*. Financial Inclusion Insights. Washington, DC, InterMedia and Seattle, USA, Bill and Melinda Gates Foundation. <https://tinyurl.com/37frb3jr>

2.2.2 Speeds

Internet connections vary in terms of speed and quality, with some providing seamless streaming and video calling capabilities, while others limit possibilities through slower speeds where even loading text-based web pages can take minutes. The difference in internet connection experiences was highlighted by an Open Data expert who described the contrast between those with fast and stable connections and those whose connections are so slow that downloading a dataset takes longer than cooking rice (Canares, 2015).

A study conducted in 2014 revealed that people in LMICs faced a moving target when it came to accessing internet speeds comparable to those available in HICs. While the gap in binary internet uptake appeared to be narrowing between HICs and LMICs, the difference in speeds experienced by users from HICs was growing at a much faster rate than the speeds available in LMICs (Hilbert, 2014). As a result, users in developing countries often found themselves playing catch-up as new technologies emerged before they could fully access and benefit from previous ones (Trendov, Varas and Zeng, 2019a).

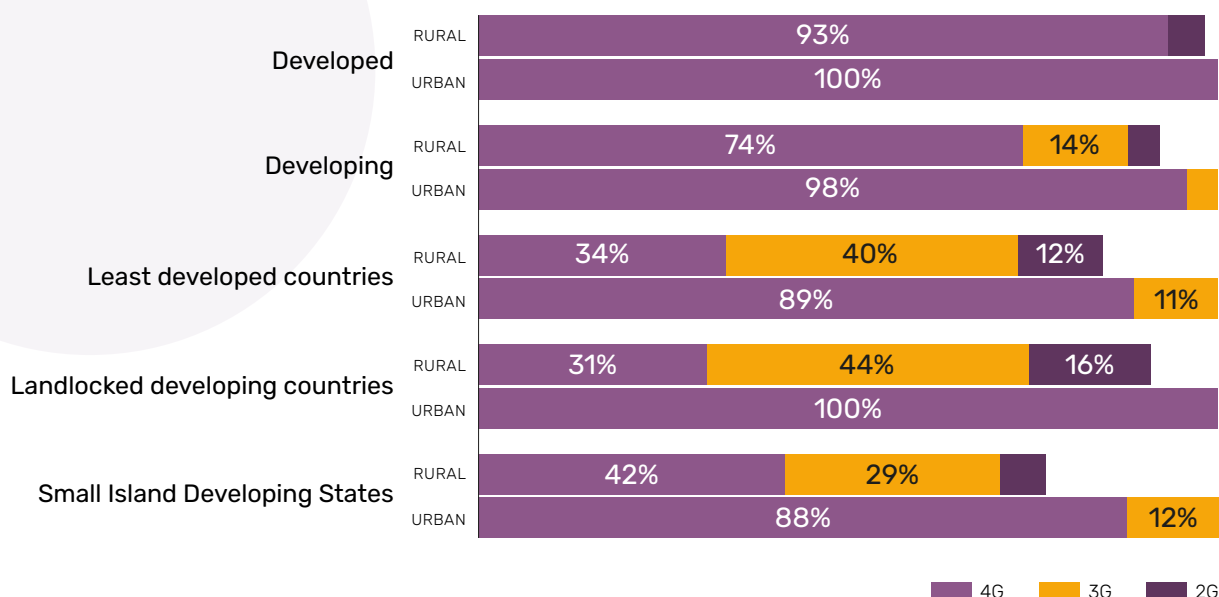
People in LMICs face a moving target when it comes to accessing internet speeds comparable to those available in HICs.

In rural areas, mobile infrastructure is generally more accessible and cost-effective to deploy compared to high-speed fibre-optic internet cables. However, significant gaps in coverage remain, particularly for the latest high-speed infrastructure. The United Nations framework on universal and meaningful connectivity recognizes the importance of high-quality infrastructure that provides fast and reliable connections (United Nations Office of the Secretary-General's Envoy on Technology and ITU, 2021). The deployment of modern telecommunications infrastructure in rural areas is not a linear process, as it requires the installation of new infrastructure or the upgrading of existing infrastructure. The urban-rural gaps in coverage for newer generations of telecommunication infrastructure are often wider than those for older technologies (See Figure 21 below).

As depicted in the graphic, significant portions of rural areas in LDCs, landlocked developing countries (LLDCs) and SIDS have access to only 3G and 2G connectivity, while newer and faster generations of mobile infrastructure are being deployed in urban areas of HICs. The reliance on older generation mobile infrastructure puts rural areas in developing countries at a disadvantage compared to rural areas in developed countries and urban areas at large.

FIGURE 21

Coverage of second-, third- and fourth-generation mobile infrastructure across development status



Note: The values for 2G and 3G networks show the incremental percentage of population that is not covered by a more advanced technology network (e.g. 95% of the world population is covered by a 3G network, that is 7% + 88%)

Source: ITU. 2021. Statistics. In: *ITU*. Geneva, Switzerland. [Cited 28 March 2024].
<https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

In countries like the United States and the United Kingdom, mobile operators have already announced plans to shut down 3G coverage, considering it as outdated technology and aiming to free up spectrum for newer generations of telecommunications infrastructure. Similar actions have been taken by operators in several European countries (Ashworth, 2021; Sweney, 2022; Hira and Agarwal, 2021). Consequently, more than half of rural residents in LDCs were covered only by mobile networks that are no longer considered suitable for users in HICs. This lag in the availability of modern telecommunications infrastructure is concerning, especially considering the ongoing deployment of 5G in well-off urban areas across different regions, including some LICs and LMICs, and the development of standards for 6G in the near future (Fisher, 2022; Ericsson, 2021).

While 5G mobile internet provides average speeds of around 100 Mbps, very few people in LDCs or rural areas of developing countries have access to it (ITU, 2021a). Even if rural areas in LICs and LMICs were to catch up in terms of 5G coverage, they would still not have access to the fastest internet speeds available to urban residents with fibre-optic broadband coverage. The disparities in fixed-broadband subscriptions between developed and developing countries are also significant, with nearly 300 million Africans living more than 50 km away from a fixed-broadband connection (African Union, 2020; FAO, 2021).

Fibre-optic broadband technology, similar to mobile broadband, undergoes generational shifts in speeds. While early adopter internet service providers are already deploying broadband technology that offers residential speeds of up to 10 gigabits per second (Gbps), the next generation (BB6) is predicted to provide residential speeds of 50 Gbps by 2030, with some enterprises having access to even higher speeds (World Broadband Association, 2022). The availability of such high-speed connections leads to the development of applications and content that require speeds beyond what mobile internet can comfortably provide, such as high-definition quality 360-degree Virtual Reality experiences.

Access to high-speed internet, in combination with other enabling factors, could empower rural residents in LDCs to access remote work, online learning and digital services on par with their counterparts in HICs. However, the definition of “high-speed” is constantly evolving, and rural areas in LLDCs, LDCs and SIDS are typically the last to receive new-generation connectivity technology. Private telecommunications companies often prioritize wealthier areas with greater purchasing power, which hinders infrastructure deployment in rural areas (United Nations Secretary-General, 2020b). Relying solely on market forces will not resolve the uneven distribution of infrastructure between urban and rural areas. Without concerted efforts to roll out fibre-optic cables and the latest generation mobile connectivity infrastructure in rural areas of LICs and LMICs, we risk perpetuating a future where urban residents in HICs and a minority of urban residents in LICs and LMICs have access to immersive technological opportunities and services that people in rural areas of LDCs, LLDCs and SIDS can only access on inadequate connections, if at all.

2.2.3 Unlimited data

There are differences between users who have limited and unlimited data. Users with limited data often ration their data to stay within their data allowance (for monthly plans) or minimize the frequency of topping up airtime (for prepaid services) (Silver *et al.*, 2019). As a result, users with limited data may refrain from data-intensive activities such as streaming or video calls. Web browsing consumes as little as 20 megabytes of data per hour, while audio streaming, video streaming, and video calling require significantly more data (Rogerson 2022). Data rationing is a common practice, with a median of 42 percent of respondents across 11 LMICs avoiding data-intensive activities on their phones (Silver *et al.*, 2019). Consequently, while smartphone owners with mobile internet connectivity theoretically have access to services like telemedicine, data unaffordability may prevent poorer users from utilizing these services or limit their usage compared to more affluent users.

The cost of 1 GB of data now represents an average of 1.7 percent of monthly GDP per capita in LMICs (GSMA, 2022a). However, 1GB of data is likely insufficient to sustain internet access for extended periods, especially for users engaging in data-intensive activities.



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Unfortunately, while the GSMA provides data disaggregated by individual income level and gender for the affordability of 1 GB of mobile data, affordability data for larger amounts of data, such as unlimited data or data allowances that users do not run out of, is not available.

It is crucial to gather data on the affordability and usage patterns of unlimited data or larger data allowances. Affordability issues disproportionately affect people living in rural areas of LMICs, as they are home to the majority of the world's extreme and moderate poor (Castaneda *et al.*, 2016).

2.2.4 Intermittent access

People's experiences of becoming internet users are not always straightforward. While statistics on internet users and mobile phone ownership may show a continuous increase, not all users remain connected or maintain ownership after their initial access. Instead, many individuals, especially those with low incomes, experience periods of disconnection following periods of usage (Gonzales, 2016). This highlights the distinction between users who can maintain continuous connectivity and those who face barriers or blackouts throughout the day, month or year. Marginalized

individuals are more likely to experience frequent disconnections (Gonzales, 2016).

Intermittent access can result from various factors, such as unpaid phone bills, reaching data limits, inability to top up prepaid data, device issues (e.g. broken, lost, stolen), or living in areas with limited or unreliable coverage (Gonzales, 2016; Mason *et al.*, 2022; Silver *et al.*, 2019). Users on monthly plans may run out of data before their billing cycle ends if they do not manage their data effectively. Prepaid users may experience periods without data if they are unable to top up immediately after exhausting their data allowance. Users with intermittent access due to affordability concerns often limit their internet usage to essential tasks to avoid running out of data (Gonzales, 2016). During periods of disconnection, users may rely on borrowing devices until they can afford to reconnect. A survey in 11 LMICs found that device issues, such as broken, lost or stolen devices, were the second most common reason (31 percent) for borrowing devices, following affordability (34 percent) (Silver *et al.*, 2019). Similarly, a study across seven LMICs revealed that 14 percent (in Pakistan) to 53 percent (in Kenya) of non-mobile phone users had previously owned a mobile phone that was lost, stolen, broken, or stopped working (Roessler, 2018).

Even when users can afford continuous connectivity, they may live, work or frequently travel to areas with unreliable or limited service. Consequently, people may experience a lack of coverage throughout the day, week or year. While disruptions in service for rural residents have been documented in places like the United Kingdom (Mason *et al.*, 2022), this phenomenon remains largely unexplored in rural areas of developing countries. Smallholder farmers, for example, may encounter varying levels of network coverage while working in their fields or travelling to markets. Seasonality could also impact intermittent access. Moreover, rural areas often have fewer service providers (Isenberg, 2019), making it less feasible to rely on multiple SIM cards or roaming to stay connected. Further research is needed to understand whether women and marginalized groups experience service disruptions more frequently or differently compared to more privileged groups.

2.2.5 Digital and other relevant skills

It is important to recognize that the lack of skills limits some users in utilizing the internet more frequently and engaging in a wider range of digital activities. Digital skills encompass more than just the technical and operational skills required to use digital devices and the internet. They also involve the ability to seek, evaluate, and utilize digital information to achieve personal and professional goals (UNESCO, 2018).

At a basic level, using digital technology often requires language literacy since many digital interactions involve text-based communication or navigating text-based content. However, language literacy poses a significant barrier for women and individuals living

in rural areas due to lower levels of education influenced by various social, economic and cultural factors. In LDCs, the literacy rate for females aged 15 and older is 54 percent, while it is 67 percent for males (UNICEF, 2021c). While average literacy rates are higher in LMICs, gender disparities still exist, albeit to a lesser extent (World Bank, 2022b). Moreover, rural areas in LDCs generally have lower literacy rates compared to urban areas (UNICEF, 2022a).

Users with adequate language literacy and basic digital skills necessary to perform basic tasks like communicating on WhatsApp may lack the skills required for more advanced activities such as online job applications, remote learning or accessing government services. Unfortunately, internationally comparable data on digital skills is limited. The ITU categorizes digital skills into three levels: basic, standard and advanced, which are also recognized in the United Nations' framework for universal and meaningful connectivity (ITU, 2021c; United Nations Office of the Secretary-General's Envoy on Technology and ITU, 2021). It is worth noting that many of the skills covered by the ITU's indicators may not apply to users who primarily use smartphones and may not be involved in tasks such as file management, spreadsheet usage, presentations or computer programming.

ITU's data collection on digital skills is not as comprehensive as its collection on standard internet use indicators, covering only 77 countries. In 2020, only 17 countries had populations where at least 60 percent of individuals possessed basic digital skills, and none reached this threshold for standard or advanced skills. Consequently, there are very few countries where a significant portion of the population possesses the standard digital skills necessary for effective office work. ITU does not provide disaggregated data on digital skills by region or gender.

TABLE 6

International Telecommunication Union categorization of basic, standard and advanced digital skills

BASIC DIGITAL SKILLS	STANDARD DIGITAL SKILLS	ADVANCED DIGITAL SKILLS
• Copying or moving a file or folder • Using copy and paste tools to duplicate or move information within a document • Sending e-mails with attached files • Transferring files between a computer and other devices	• Using basic algorithmic formula in a spreadsheet • Connecting and installing new devices • Creating electronic presentations with presentation software • Finding, downloading, installing and configuring software	• Writing a computer program using a specialized programming language

Source: ITU. 2021. The ITU ICT SDG indicators. In: *ITU*. Geneva, Switzerland. [Cited 28 March 2024]. <https://tinyurl.com/3ere3txk>

As societies undergo digitization, the skills required to remain digitally included and address emerging risks continue to evolve and expand (UNESCO, 2018). New challenges such as the spread of “fake news” and targeted disinformation highlight the importance of critical assessment and verification of information sources, even when they align with existing biases or worldviews (UNESCO, 2018). The increasing prevalence of sophisticated phishing and ransomware attacks emphasizes the need for cyber hygiene skills to protect personal information from cyber-attacks (Vishwanath *et al.*, 2020).

It is crucial to recognize that the necessary digital skills to fend off digital exclusion are not static and will continue to evolve as technology advances.

It is crucial to recognize that the necessary digital skills to fend off digital exclusion are not static and will continue to evolve as technology advances. Users will need to repeatedly adapt and acquire new skills to fully participate online securely while leveraging digital technology to achieve their goals. The development of digital skills is influenced significantly by the role of the state (UNESCO, 2018). However, many LDCs and LMICs face capacity limitations in investing in and implementing digital-skills training, which requires the support of the establishment and lifelong maintenance among rural populations. Considering the ever-changing nature of digital skills, these efforts should extend beyond one-off training programmes. Additionally, it is vital to build the capacity of national and local governments to implement digital-skills training initiatives effectively.

2.2.6 User autonomy

User autonomy refers to the degree of control individuals have over their use of digital technology, including when, how, and for what purposes they use it (Schradié, 2018). Ownership of devices and the context of internet usage play a significant role in determining user autonomy. Users who own their own devices and have unrestricted access throughout the day have the highest level of autonomy. On the other hand, users who rely on borrowed devices tend to spend less time online and engage in fewer internet activities (DiMaggio and Hargittai, 2001; Girl Effect, 2018), and marginalized groups are more likely to borrow devices.

Mobile phone sharing is prevalent in rural areas, with individuals in these areas more likely to borrow devices compared to those in peri-urban and urban areas (Wesolowski *et al.*, 2012). Women in rural areas, particularly those who are poor and have lower levels of education, are significantly more likely to rely on borrowed devices (Wesolowski *et al.*, 2012). Moreover, when women’s access to phones is mediated by men, they often have limited access to the devices, usually at specific times of the day or week (FAO, 2018a). Further research is needed to understand how device-sharing practices in rural areas impact user autonomy and outcomes. Existing research shows that girls across different countries are more likely to have their access mediated by a family member, usually a male, which results in restrictions such as having to ask permission to use a

mobile device and having their digital activities monitored (Girl Effect, 2018). Borrowing devices restricts users' ability to explore and discover information, websites or services relevant to their needs and interests. It also limits users' opportunities to improve their digital skills through regular use. Affordability is the most commonly cited reason for borrowing a device, particularly among individuals in rural areas (Silver *et al.*, 2019).

Similarly, users who rely on public computers in telecentres or computer labs have lower autonomy compared to those who own their own devices and have continuous access to the internet at home or through mobile devices throughout the day. While telecentres and other public access points can improve basic access and enable users to engage in certain online activities, they might not otherwise have access to, the experience of relying solely on public internet access differs qualitatively from owning personal devices and having access at home. Users who can only access the internet at a friend's or family member's home also have limited autonomy compared to those who can access it in their own homes. Public access points have limited operating hours, whereas home access is available 24/7. Consequently, users relying on public connectivity tend to prioritize essential tasks with immediate benefits, while users with greater autonomy are more likely to explore the internet and develop their digital skills (Robinson, 2009). Users with continuous and autonomous access are more inclined to create content, whereas those with lower autonomy primarily consume content (Schradie, 2018).

2.2.7 Proxy usage

Certain users, known as "proxy users," rely on others to access digital information or services (Selwyn *et al.*, 2016). The need for proxies is not a binary distinction between users who require assistance for all their digital activities and those who can independently navigate the online world. Instead, the level of proxy assistance can vary. Some users may be proficient in basic digital activities such as making phone calls, using social media or messaging apps, and conducting online searches, but require assistance for more complex tasks like filling out online forms or applying for jobs. Proxies may also be sought for activities that users do not regularly perform, such as downloading apps or setting up accounts. Similar to those who rely on shared devices, proxy users tend to engage primarily in essential internet activities while avoiding exploratory and creative online pursuits (Selwyn *et al.*, 2016).

Proxies can be individuals who are trusted by the user, such as family members or friends, or they can be personnel working in community-based organizations (CBOs) or individuals who charge fees for performing digital tasks on behalf of others. These relationships have significant implications for the activities that proxy users feel comfortable delegating and the information they are willing to share with their proxies. Formal arrangements involving proxies have been observed in LIC and LMIC settings. For

instance, Grameen Foundation employs Community Knowledge Workers in rural Uganda who act as intermediaries between farmers and extension services facilitated through smartphones (FAO, 2018b). Evidence suggests that female intermediaries are often more effective at reaching female farmers, highlighting the importance of training and involving more women in intermediary roles (FAO, 2018a). In Bangladesh, “Info-ladies” travel to remote villages on bicycles equipped with laptops, Universal Serial Bus (USB) sticks, and headphones to help people, particularly rural women, access the internet and cater to their specific needs. In the United Kingdom and the United States, CBOs that typically do not focus on digital inclusion found themselves providing digital support during the pandemic to ensure community members could access essential services that had transitioned online. Many of these organizations offered their support without compensation or recognition for their role in preventing digital exclusion (Hernandez and Faith, 2020).

Further research is needed to explore whether rural CBOs in LICs and LMICs also engage in unrecognized and uncompensated digital-inclusion work. It is necessary to provide financial support and capacity-building initiatives for proxies in rural areas to enhance their ability to deliver digital-inclusion support. The first step would involve mapping out CBOs, NGOs and other actors that currently serve as proxies without adequate support.

2.2.8 Quality of devices

Device ownership and the type of devices used have a significant impact on the user experience in the digital realm. While studies on the first-level digital divide often group all mobile phone and smartphone owners together, the functionality and capabilities of different devices make a difference. Feature phones provide limited functionality, smaller screens and may not support video content or internet connectivity, which restricts the amount and format of information that can be accessed and shared. Ownership and access gaps between privileged and marginalized groups tend to be wider for newer and more advanced devices. For example, women are less likely to own any type of mobile phone and even less likely to own a smartphone compared to men (GSMA, 2022b). Moreover, the experiences with smartphones are not uniform. Smartphone manufacturers release new flagship devices with improved performance, software features (including those utilizing artificial intelligence), processing speeds, sensors and cameras on an annual basis. People living in poverty often have access to older, slower devices with fewer features and lower-quality cameras (Maréchal, 2017).

Many advanced software features introduced by smartphone manufacturers are exclusively available on newer and more expensive devices with significantly more processing power, which remains unaffordable for many rural residents in LICs and LMICs. These features could be beneficial for people in rural areas, such

as real-time on-screen and live audio translations of text, audio, and video (including calls) without internet connectivity. However, these technologies are not accessible on older and cheaper devices commonly used by residents in LICs and LMICs.

While some device owners can afford to purchase new devices or replace broken or stolen ones every few years, others are using phones that are five years or older. Many smartphones from just a couple of years ago do not support 5G connectivity, and a significant proportion of smartphones sold in 2022 are still 4G phones. Some smartphones from the mid-2010s do not even support 4G connectivity. As a result, users with older devices are unable to access the fastest mobile broadband speeds available to them, particularly in SSA where 3G connectivity is expected to peak in 2023 despite over half of the population being covered by a 4G signal. SSA is projected to have only 28 percent 4G adoption by 2025, compared to the global average of 57 percent (GSMA, 2021b). The lack of affordable 4G-enabled phones is cited as one of the main barriers to 4G adoption in the region (GSMA, 2021c).

The physical condition of a mobile phone can also impact the user experience and functionality. Users with cracked screens or damaged speakers may encounter difficulties in browsing the web or comprehending audiovisual content. Additionally, users with slow devices that frequently freeze may experience significant delays in completing tasks compared to users with newer devices (Faith, 2018). A survey by Silver *et al.* (2019) revealed that broken or stolen devices were the second most commonly cited reason for borrowing mobile phones in 11 LICs and LMICs.

2.2.9 Device type

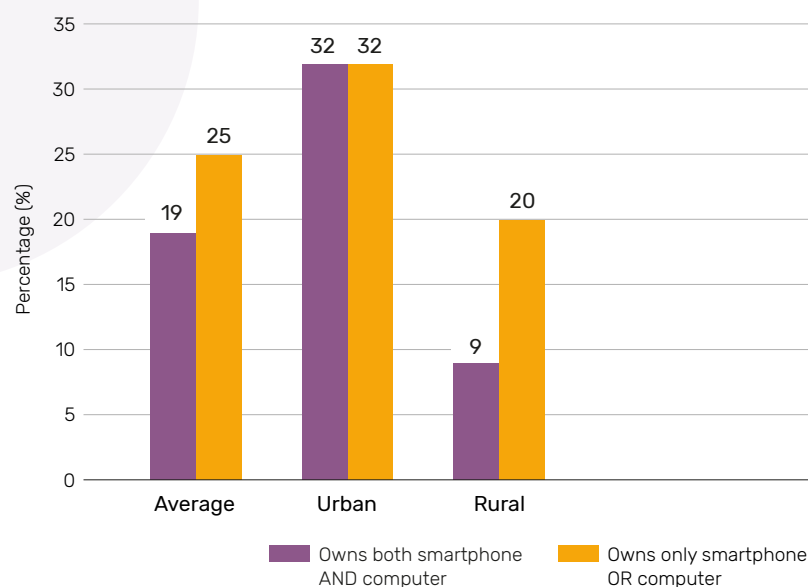
While smartphones have become increasingly powerful and offer a wide range of functionalities, it is important to recognize that computers and laptops still provide a better user experience for certain activities. Reading lengthy reports or conducting in-depth research, inputting data into spreadsheets, and participating in remote learning are examples of activities that are more suited for computers or laptops due to their larger screens and enhanced capabilities. The United Nations framework on universal and meaningful connectivity acknowledges that while basic mobile phones and smartphones are more affordable, desktop computers generally offer a richer experience (United Nations Office of the Secretary-General's Envoy on Technology and ITU, 2021).

For instance, when it comes to online courses or video calls involving multiple participants, smartphone screens may not provide an optimal experience, especially when text-heavy slides or the faces of numerous classmates or colleagues need to be displayed (Parsons, Thomas and Wishart, 2016). Nonetheless, smartphones have the advantage of portability, instant access and the ability to stay connected while on the go. Ideally, users would

have access to both types of devices to take advantage of their respective capabilities. Unfortunately, this is often not the case in LICs and LMICs, particularly in rural areas.

A recent survey conducted across 34 SSA countries in 2018 (See Figure 22 below) revealed that only 19 percent of individuals had access to both a smartphone and a computer, with nine countries reporting less than 10 percent of people having access to both devices (Kronke, 2020). The disparity between rural and urban areas is particularly significant, as only 9 percent of rural respondents lived in households owning both smartphones and computers, compared to 32 percent of urban respondents (Kronke, 2020).

FIGURE 22
Percentage of people with access to personal computers and smartphones vs only a smartphone or personal computer across 34 sub-Saharan African countries disaggregated by geography



Source: Kronke, M. 2020. *Africa's digital divide and the promise of e-learning*. Afrobarometer Policy Paper No. 66. Accra, Afrobarometer. <https://tinyurl.com/56ur44ua>

2.2.10 Safety of old devices

One crucial aspect of digital inequality that is often overlooked is the age of the device being used, which has significant implications for user experience and security. Smartphones can be targeted by hackers who exploit vulnerabilities in the device's software. While mobile manufacturers release security patches to address these vulnerabilities, not all smartphones receive equal coverage in terms of security updates.

Although the literature on digital exclusion does not currently delve into questions of secure phones, it is an area that warrants further exploration, especially in LICs and LMICs, particularly in

rural areas where ownership of older and second-hand phones may be more prevalent. This raises concerns that people in rural areas who purchase second-hand phones may unknowingly use insecure devices from the beginning.

In addition to the lack of hardware security patches, many smartphone manufacturers cease providing software updates three years after the release of their devices. This becomes problematic from a security perspective as hackers exploit vulnerabilities in outdated hardware and operating systems. It also hinders users who wish to download, update and use apps. App developers often stop supporting older operating systems, rendering certain apps incompatible with outdated devices.

For instance, Microsoft Teams only runs on Android devices equipped with the four latest major Android operating system versions. Consequently, Android devices that have not received software updates since 2018 (as of December 2022) would be unable to download, update, or use the app (Microsoft, n.d.). Similarly, Apple devices no longer receive updates for phones running operating systems released before 2020 (as of December 2022) (Moore, 2021). The lack of support for older operating systems by app developers means that owners of outdated phones, no longer receiving software updates, may be unable to access certain apps and may find themselves excluded from digital services they may require or desire.

To address these challenges, it is essential to raise awareness among partners regarding the potential security risks associated with providing beneficiaries with refurbished or older phones that may no longer be supported with software updates or security patches. When feasible, efforts should be made to upgrade these devices to ensure they have access to necessary security patches and software updates.

2.2.11 Inclusion at a disadvantage

As digitalization becomes increasingly pervasive, individuals are expected to engage in various economic, social, political and leisure activities using digital technologies. Accessing the internet is no longer solely a matter of choice but has become a necessity (Faith, Hernandez and Beecher, 2022). Consequently, individuals who lack the necessary devices, internet access, fast internet connection, digital skills, autonomy over their digital use, or continuous connectivity must find ways to participate in the digital realm.

Users who face after-access barriers are included on unequal terms. In some cases, these barriers can lead to digital exclusion when content, services or processes are exclusively available online. For users facing after-access barriers, accessing digital services may require more effort, be slower, less seamless or come at a disproportionately higher cost. Users with slow internet may need to disable video during telehealth consultations, thereby missing

out on the full benefits of the experience. Users with limited digital skills may take significantly longer to complete forms correctly or require assistance from peers. Users who only have smartphones may struggle to keep up with remote courses. Those with outdated devices may need to borrow a friend's device to access digital services that require specific apps their own device cannot run. Rural users in areas with unreliable coverage may have to avoid certain locations, including their workplaces, if they are awaiting important calls due to inadequate mobile signals. Users whose internet access is mediated by others may need to navigate relationships carefully to maintain access.

However, overcoming these barriers may not be sufficient to ensure that, in general, smallholder farmers and rural populations can fully benefit from their use of digital technology on par with urban users. Structural, spatial and group-based inequalities hinder equitable benefits from digital technology use for people residing in rural areas, rural women and other marginalized rural groups. These structural disadvantages encompass limited economic resources, lower levels of human capital, less influential and dispersed social networks, reduced civic and political power, entrenched social norms, underrepresentation and the absence of an enabling environment characterized by low local institutional capacity and dysfunctional local markets.

BOX 6

A4AI's Meaningful Connectivity Index

The Alliance for Affordable Internet (A4AI) and the Web Foundation have developed the Meaningful Connectivity Index. This index combines four indicators to assess whether individuals have the potential to be active participants in digital societies. These indicators include owning a smartphone or powerful digital device, using the internet daily, having access to high-speed internet (at least 4G), and having unlimited data at a regularly accessed location.

Meaningful connectivity has been shown to be a good proxy for assessing inclusion in digital technology usage. Users who meet the criteria for meaningful connectivity are more likely to engage in essential online activities, such as taking classes, accessing health care, seeking employment, participating in the digital economy, and posting on social media. However, meaningful connectivity index scores are not yet widely available for all countries.

Early surveys conducted by A4AI in nine low-income countries and lower-middle-income countries (Colombia, Ghana, India, Indonesia, Kenya, Mozambique, Nigeria, Rwanda and South

Africa) revealed that only 10 percent of individuals in these countries met the criteria for meaningful connectivity (Figure A). This is significantly lower than the percentage of individuals considered connected based on the traditional internet user metric used by the International Telecommunication Union, which counts individuals as internet users as long as they have used the internet once in the three months preceding the survey.

These findings highlight the importance of considering after-access barriers and meaningful connectivity to assess the true level of digital inclusion and address the challenges that individuals still face even with access to the internet.

A4AI's research reveals significant gender and geographical disparities in achieving meaningful connectivity within countries. Urban residents and men are more likely to have meaningful access to the internet (Figures B and C). The urban-rural gap in meaningful connectivity reached as high as 6.3 times in Rwanda (1.9 percent vs 0.3 percent as shown in Figure B).

However, the A4AI study found that men were nearly twice as likely as women to have meaningful access to the internet (Figure C) (A4AI, 2022). These findings align with research conducted on digital inequality in Europe, which demonstrated that despite bridging the binary digital divide, gendered digital inequality persisted in terms of usage patterns and time spent online (Van Dijk, 2012).

Additionally, A4AI identified a gender gap in meaningful connectivity across all nine surveyed countries, even in cases where ITU statistics suggested that the gender gap had been bridged. For instance, based on the latest available ITU gender disaggregated data from 2019, women in Colombia were slightly more likely to be online than men (ITU, 2021b).

The findings from A4AI's research highlight a concerning reality: only around 10 percent of people in the nine LICs and LMICs surveyed are considered meaningfully connected. Factors such as digital skills,

the need for assistance to complete digital tasks, the condition of devices, software and security updates and intermittent access are not captured by the meaningful connectivity index. When taking all these factors into account, it is likely that the number of users who are online without facing additional barriers is even lower than 10 percent across these countries. This raises serious concerns about the extent of digital exclusion faced by rural residents in LICs, MICs, LDCs and SIDS.

The Inter-American Institute for Cooperation in Agriculture has recently adapted A4AI's Meaningful Connectivity Index to create a Rural Significant Connectivity Index for countries in LAC. The study revealed that 77 million rural individuals in 24 countries in the region lack meaningful access to the internet, with significant disparities between urban and rural areas (Ziegler *et al.*, 2020). Rural residents were found to be almost half as likely as their urban counterparts to have meaningful connectivity.

Sources: A4AI. 2022. *Advancing meaningful connectivity towards active and participatory digital societies*. Washington, DC, Alliance for Affordable Internet. <https://tinyurl.com/yc7feazh>

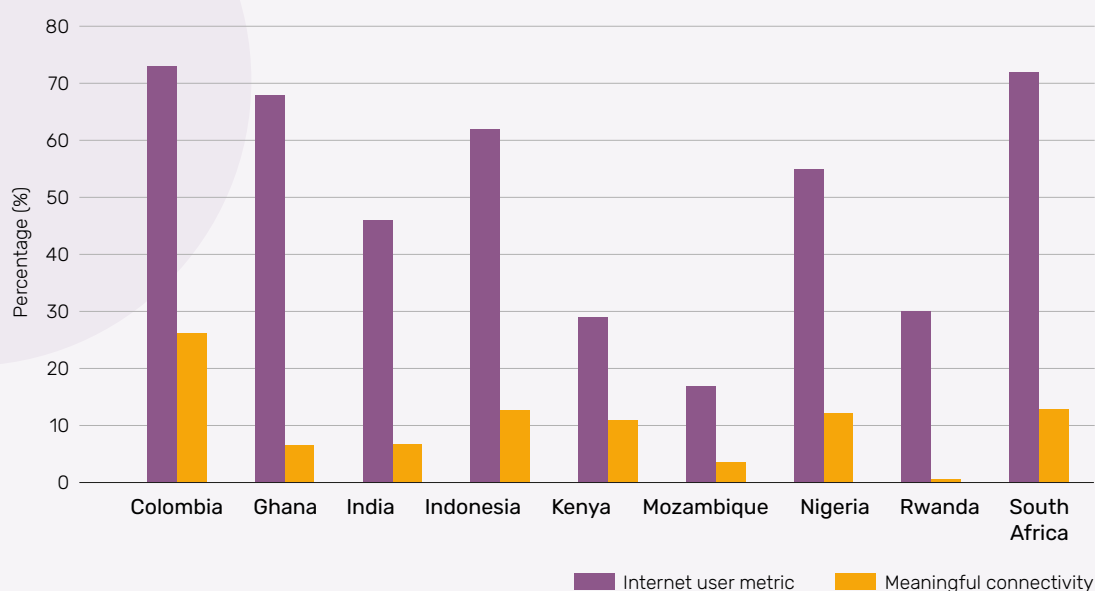
ITU. 2021. Statistics. In: *ITU*. Geneva, Switzerland. [Cited 28 March 2024]. <https://tinyurl.com/48kcy5p3>

Van Dijk, J.A.G.M. 2012. The evolution of the digital divide: The digital divide turns to inequality of skills and usage. In: J. Bus, M. Crompton, M. Hildebrandt & G. Metakides, eds. *Digital Enlightenment Yearbook 2012*, pp. 57–75. Amsterdam, The Kingdom of the Netherlands, IOS Press.

Ziegler, S., Arias Segura, J., Bosio, M., Camacho, K. & Eje Transversal Innovación y Tecnología (ETIT). 2020. *Rural connectivity in Latin America and the Caribbean. A bridge for sustainable development in a time of pandemic*. San José, Inter-American Institute for Cooperation on Agriculture, Washington, DC, Inter-American Development Bank, and Seattle, USA, Microsoft. <https://tinyurl.com/bwkbn332>

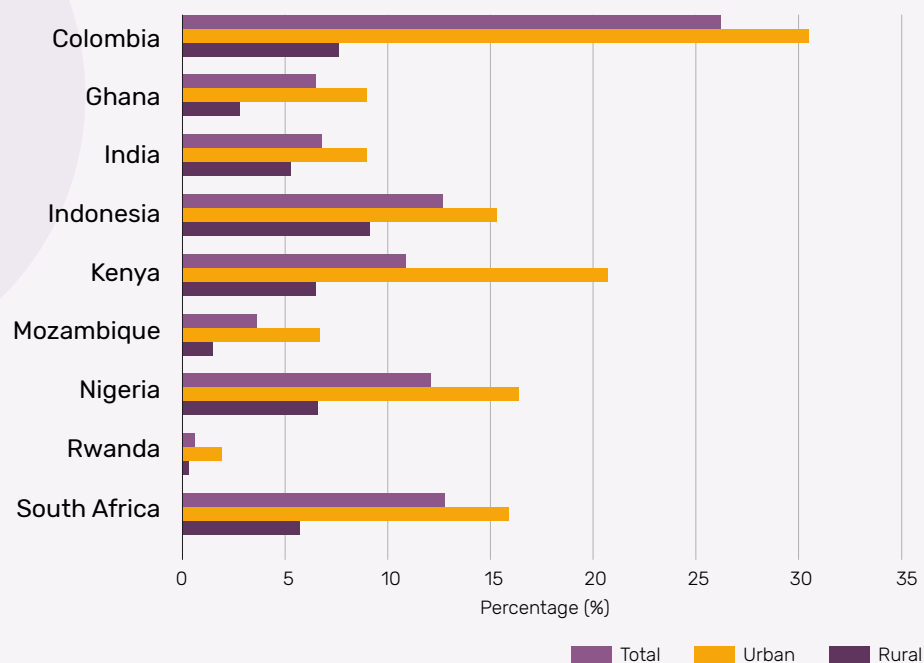
FIGURE A

ITU internet user metric vs Alliance for Affordable Internet meaningful connectivity in nine low-income and lower middle-income countries in 2021

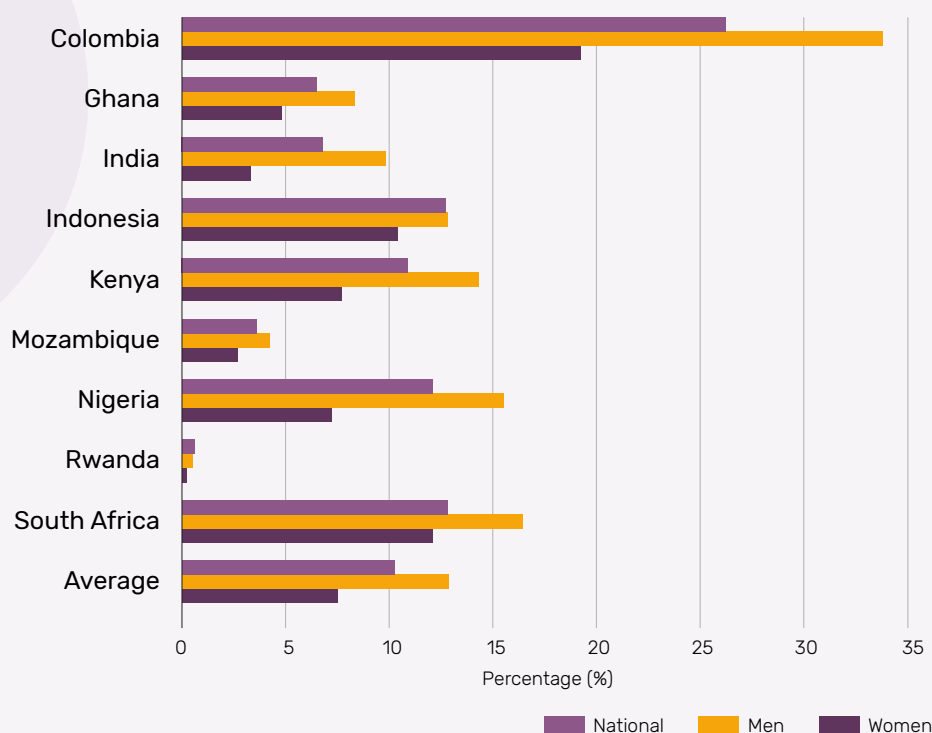


Sources: A4AI. 2022. *Meaningful connectivity for rural communities: Geographic barriers & policy strategies for digital inclusion*. Washington, DC, Alliance for Affordable Internet. <https://tinyurl.com/3d8pclub>

ITU. 2021. Statistics. In: *ITU*. Geneva, Switzerland. [Cited 28 March 2024]. <https://tinyurl.com/48kcy5p3>

FIGURE B**Meaningful connectivity in rural vs urban areas in nine low-income and lower middle-income countries**

Source: A4AI. 2022. *Meaningful connectivity for rural communities: Geographic barriers & policy strategies for digital inclusion*. Washington, DC, Alliance for Affordable Internet. <https://tinyurl.com/3d8pchub>

FIGURE C**Meaningful connectivity women vs men in nine low-income and lower middle-income countries in 2021**

Source: A4AI. 2022. *Advancing meaningful connectivity towards active and participatory digital societies*. Washington, DC, Alliance for Affordable Internet. <https://tinyurl.com/yc7feazh>

BOX 7

The United Nation's framework on universal and meaningful connectivity

The United Nations framework for universal and meaningful digital connectivity, developed in line with the UN Secretary-General's Roadmap for Digital Cooperation, recognizes the importance of both universal and meaningful connectivity. The framework acknowledges that access to digital spaces is essential for various activities and services, and it aims to establish a baseline that ensures individuals have sufficient access to digital technologies.

Meaningful connectivity, as defined by the framework, consists of five connectivity enablers: skills, infrastructure, affordability, device, and safety and security. Each of these enablers contributes to ensuring that individuals, households, communities and businesses can fully benefit from digital technology. For example, meaningful access to infrastructure means having access to fast and reliable connectivity, while meaningful affordability involves access to affordable internet-enabled devices and internet subscriptions. Digital skills and the ability to navigate digital spaces safely are also crucial components of meaningful connectivity.

The UN framework aims to track progress towards meaningful connectivity for each UN member state through interactive country dashboards established by the International Telecommunications Union. These

dashboards will help monitor advancements in the different connectivity enablers and overall progress towards meaningful connectivity.

While the UN framework includes digital skills as an important aspect of meaningful connectivity, it has some limitations compared with the Alliance for Affordable Internet's Meaningful Connectivity Index (which does not include skills). The UN framework does not emphasize the frequency of internet use, and it places less importance on the type of device and speed of connectivity. For example, any internet-enabled device is considered sufficient, and 3G speeds are accepted in some contexts.

One significant limitation of the UN framework is that it measures indicators independently, which may underestimate the number of individuals experiencing after-access barriers. This makes it challenging to determine the extent of digital exclusion and the number of people at risk of being left behind.

Overall, while the UN framework recognizes the importance of meaningful connectivity, there are areas where it can be further refined to provide a more comprehensive assessment of digital inclusion and address the barriers individuals may face after accessing the internet.

Source: United Nations Office of the Secretary-General's Envoy on Technology & ITU (International Telecommunication Union). 2021. *Achieving universal and meaningful digital connectivity. Setting a baseline and targets for 2030*. New York, USA, United Nations. <https://tinyurl.com/425ju9mn>

2.3 Structural inequalities and root causes of digital inequalities

The third level of the digital divide focuses on the inequalities in outcomes arising from using digital technologies. It highlights the disparities in users' ability to extract economic, social, cultural and civic benefits from their use of digital technologies. These outcomes are closely linked to the achievement of the SDGs (Helsper, 2021; Schradie, 2018). FAO has also emphasized the importance of considering sociocultural and economic inequalities in understanding the spread and impact of ICTs (Isenberg, 2019).

As discussed in the previous sections, the first- and second-level digital divides are strongly correlated with offline inequalities. Rural populations, women, and marginalized groups are less likely to have digital access and are more likely to face barriers even when they gain access. The third-level digital divide demonstrates



Addressing structural inequalities is essential for reducing unequal well-being outcomes from digitalization among marginalized groups.

how digitalization can not only reproduce but also perpetuate and exacerbate offline inequalities, creating a vicious cycle. Digital technologies tend to amplify existing offline inequalities (Toyama, 2011). Digital divides often stem from the same economic, spatial, and social divides that already exist in rural areas (Schroeder, Lampietti and Elabed, 2021). Rather than providing disadvantaged users with equal opportunities to improve their well-being, digital technologies disproportionately strengthen the capacities of users with greater offline resources. Wealthier individuals are able to leverage their offline resources through digital technology, further enhancing their positions in society. In contrast, disadvantaged groups often lack the resources to leverage digital technology in a way that equally benefits their socioeconomic status.

The corresponding fields model provides a useful framework for understanding the third-level digital divide. It illustrates how users' access to offline capital, including economic, social, civic and cultural resources, shapes their ability to benefit from digital technology (Helsper, 2012). As a result, digital technology does not replace or compensate for the lack of offline resources; instead, it tends to reinforce existing inequalities. The following subsections will explore how offline inequalities are reinforced through the use of digital technologies. In addition to the axes of inequality covered in the corresponding fields model (economic, human, social, and civic capital), this section will also consider other important dimensions such as social norms, representation, market functioning and local institutional capacity, particularly in rural areas.

2.3.1 Economic resources

Users with greater economic resources have the ability to purchase the latest digital equipment, subscribe to productivity-enhancing digital services, and even invest their money in rapidly growing digital firms. For instance, wealthier farmers with larger landholdings can acquire farming machinery equipped with sensors that connect with other sensors on the farm, providing real-time information and enabling precision agriculture (Hackfort, 2021). Similarly, wealthier farmers located near urban areas can employ staff with digital and data science skills to fully leverage data-driven insights (Hackfort, 2021). However, this ability of wealthier farmers to invest in digital technology and hire skilled personnel can further widen the inequalities between larger and smallholder farmers, who may only have access to basic digital advisory services. Unless the economic prospects of smallholder farmers and rural populations in general improve, and spatial inequalities are reduced, digitalization could potentially exacerbate the relative disadvantages faced by farmers and rural communities.

A study by FAO revealed that although some farmers are adopting emerging technologies such as artificial intelligence, agricultural bots, precision agriculture and blockchain, there are still significant disparities in their access and utilization.

Female smallholder farmers face particular challenges in leveraging digital technology to improve their economic prospects, as they often operate smaller farms, use fewer inputs, and have fewer and smaller livestock compared to male farmers (Isenberg, 2019). In addition to potentially exacerbating inequalities between smallholders and larger farmers, digitalization in agriculture carries the risk of deepening urban–rural divides and widening economic disparities, leading to the migration of people and industries away from rural areas and resulting in long-term economic and social decline (FAO and Zhejiang University, 2020).

The lack of financial capital, including limited access to credit markets, poses a significant constraint for smallholders seeking to enhance the productivity and profitability of their agricultural activities, hindering their ability to engage in more commercially oriented agriculture (Fan and Rue, 2020). It is worth noting that rural areas are home to 80 percent of the global population living in extreme poverty and 75 percent of the global population living in moderate poverty, with the majority engaged in agriculture



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(Castaneda *et al.*, 2016), despite rural areas accounting for only 44 percent of the world's population in 2020 (World Bank, 2022b). Consequently, smallholders in rural areas face significant barriers in harnessing their economic resources through digital technology.

2.3.2 Human capital

The World Bank's *World Development Report on the Changing Nature of Work* emphasizes the importance of building human capital to ensure inclusivity in the digitalized workforce. Individuals with higher levels of human capital, including advanced digital and cognitive skills, are better equipped to adapt to technological changes (World Bank, 2019b).

As workplaces and industries undergo digitalization, workers with higher levels of education and advanced skills have a greater advantage in leveraging their abilities to earn higher incomes compared to those with lower education and skills (Brynjolfsson and McAfee, 2014). This is because digitalization tends to replace repetitive tasks with technology, requiring workers to possess higher-level digital and cognitive skills for new tasks and roles. The increased demand for highly skilled workers and decreased demand for middle- and low-skilled workers has led to labour-market polarization, initially observed in developed countries but now prevalent in developing countries as well (United Nations, 2020).

Less educated workers without a college degree have been the least able to benefit from – and the most disrupted by – technological changes. For instance, Kenyan farmers with higher levels of education are more likely to adopt digital financial technology platforms for marketing compared to farmers with primary education or less (Mercy Corps Agrifin Accelerate, 2019; Yeboah and Flynn, 2021). Educational attainment in rural areas of LICs and LMICs remains below average, with limited infrastructure, resources, higher dropout rates, and less effective learning (Trendov, Varas and Zeng, 2019a). Rural youth often face the challenge of balancing work responsibilities, leaving them with less time for schooling or studying (Trendov, Varas and Zeng, 2019a).

DIGITAL TECHNOLOGIES often require significant financial resources, large farm sizes and close integration with other technologies and agrifood chain processes. It is therefore a greater challenge for small-scale farmers to adopt such technologies, whereas larger farmers and agribusiness companies will be more easily able to implement them (Trendov, Varas and Zeng, 2019a, p. 13).

Digitalization increases the returns on education, particularly for highly educated workers, while reducing the demand for workers with lower education levels (Brynjolfsson and McAfee, 2014; World Bank, 2019b, 2016). Disparities in educational attainment are significant between urban and rural areas, with even greater gaps in secondary and tertiary education. For example, in South Asia, rural upper secondary school completion rates are 32 percent compared to 50 percent in urban areas, while in SSA, the rates are 15 percent for rural areas and 44 percent for urban areas (UNICEF, 2022b). The Malala Fund (2018) estimates that over 1 billion girls and young women under the age of 24 are at risk of being left behind by digitalization due to their limited access to at least secondary-level education. Improving education and human capital outcomes is

crucial to enhancing employment and earning potential for rural populations as workplaces continue to digitalize.

Online distance learning has the potential to enhance the availability and quality of education and teacher training in rural areas, benefiting rural women and other marginalized groups (FAO, 2018a; FAO and Zhejiang University, 2020). It can also improve access to advisory and extension services by overcoming barriers related to poor infrastructure and high costs associated with visiting farmers in remote areas, which often results in one-time information delivery (FAO, 2018b). However, as noted by prominent digital development scholar Kentaro Toyama, expecting the internet to provide education where education systems are lacking is akin to expecting a student driver to drive themselves to driving lessons (Toyama, 2011).

2.3.3 Social capital

Social networks play a crucial role in accessing knowledge and support, particularly during times of need. However, there is a strong correlation between wealth and the size and influence of social networks. Wealthier individuals tend to have larger social networks that include more powerful and influential people, providing them with a greater support system (Smith, Menon and Thompson, 2012). Rural women in LICs and LMICs often have smaller social networks that revolve around family (GSMA, 2021d). While digital technologies have been seen as a means to help individuals with weaker social networks expand their connections, research has revealed a “Matthew Effect” where better-off groups are more successful in growing their social networks online (Neves and Fonseca, 2015).

For smallholder farmers, social networks without ties to merchants can hinder their ability to leverage mobile phones for better prices for their products. Van Campenhout (2017) found that providing farmers with a directory of traders improved their chances of receiving better prices. However, rural residents need connections that extend beyond market directories to improve development outcomes related to health, employment, clean water and sanitation, and citizen participation. For instance, a lack of social connections to people with digital skills limits opportunities for acquiring digital skills, with rural women being particularly disadvantaged in having peers with such skills (GSMA, 2021d).

It is essential to build digital and non-digital social networks among rural residents in different areas and establish connections between rural and urban areas with sympathetic groups. Urban residents, who have physical proximity to and greater visibility by politicians, powerful actors and the media, can be crucial in supporting rural residents (Kosec and Wantchekon, 2020). This would enable rural residents to organize with networks in urban areas and other rural areas during times of need to facilitate collective action.



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2.3.4 Social norms

Social norms play a significant role in restricting people's access to and use of digital technology, particularly, women's access in male-dominated societies. Women and girls often face restrictions imposed by male and older female gatekeepers, leading to limited digital access (Buskens and Webb, 2009). Using mobile phones and accessing digital technology can be frowned upon for women, and they may lead to marital problems or suspicion of infidelity from their husbands in male-dominated contexts (FAO, 2018a). Concerns about harassment, unsolicited messages, and calls further hinder women's use of technology (FAO, 2018a). Even when women have access, it is often mediated or monitored, and they are less likely to be allowed to use technology for as wide a range of activities as men and boys (Girl Effect, 2018). Mediated access can also restrict the timing of women's phone use to specific times of the day or week (FAO, 2018a). In some cases, women and girls are discouraged from visiting telecentres or internet cafes due to concerns about male presence (FAO, 2018b).

Marginalized minority groups, including racial, ethnic, religious, and linguistic minorities, are more likely to experience online harassment and hate speech (Castaño-Pulgarín *et al.*, 2021; Jane, 2017). Women from marginalized backgrounds in male-dominated societies face

double backlash from both the dominant society and their own community. For example, Rohingya women may face taboos against owning mobile phones, and those who speak out about women's rights on social media are threatened and intimidated online and offline (Morshed *et al.*, 2021; Hölzl, 2021).

Changing social norms in male-dominated societies and addressing discrimination and oppression are crucial for improving internet connectivity for marginalized rural residents. Engaging men and boys is essential in enabling sustainable change, as gatekeepers must be convinced to support women's digital inclusion (FAO, IFAD and WFP, 2020). Building trust and demonstrating socially acceptable use cases for digital access can help overcome barriers. Taking a family or community-based approach, where all members, including men, are informed and involved in initiatives can help foster understanding and support for digital inclusion (FAO, 2018b).

2.3.5 Civic/political capital

Digital technologies, including social media, have been hailed for their potential to lower the costs of political participation and empower marginalized individuals and groups. While digital technologies are increasingly used by social movement organizations working on various issues, their effectiveness in leveraging digital tools depends on access to offline networks, resources and processes.

Research by Schradie (2018) highlights that working-class political movements often have fewer organizational resources, including funding, staff and access to functional digital hardware and internet. Additionally, members of working-class movements tend to have lower levels of digital skills, limiting their ability to benefit from digital technologies. These movements are less likely to have websites or a strong social media presence, and they generally have fewer followers and less engagement compared to middle and upper-class movements. On the other hand, middle and upper-class social movements tend to have more resources, including funding and staff dedicated to social media, enabling them to leverage digital technology more effectively to achieve their goals.

Therefore, the digitalization of activism can contribute to inequality in participation rather than equalizing it. It amplifies existing disparities between different social movements based on their access to resources and digital skills. In this context, it is important to continue supporting and funding local rural advocacy groups. Investments in digital equipment and digital-skills training should be viewed as complementary to existing efforts rather than a replacement.

Recognizing the specific needs and challenges faced by different movements and providing appropriate support will help bridge the digital activism inequality gap and ensure that digital technologies are used to promote inclusive and equitable participation.

2.3.6 Local institutional capacity

FAO's Science and Innovation Strategy recognizes the role of strong institutions, political will, good governance, and enabling regulatory frameworks in the success of digital innovations (FAO, 2022). This understanding is supported by evidence from digital development projects, which have consistently shown that the mere introduction of technology is not sufficient to achieve development outcomes. Instead, the presence of capable local governments and organizations, as well as the alignment of digital development goals with the political agenda, are crucial factors for achieving positive results (Toyama, 2015, 2011). In other words, technology cannot substitute for missing institutional capacity and human intent. Technology projects in global development are most successful when they amplify already successful development efforts or positively inclined intent, rather than seek to fix, provide, or substitute for broken or missing institutional elements (Toyama, 2011).

Digital technologies have been seen as a potential tool for improving government transparency, accountability and democratic governance, particularly in rural areas (Edwards *et al.*, 2016; McGee, 2014; Peixoto and Fox, 2016). However, the political empowerment of rural residents through digital technologies requires a combination of capacity, power and incentives to act on the information provided, as well as the willingness and competency of politicians to address the demands of rural residents (Kosec and Wantchekon, 2020). Unfortunately, these factors are often lacking in rural settings, where low levels of literacy, limited physical mobility due to inadequate roads, and limited access to politicians who predominantly reside in urban areas pose challenges.

Improving the responsiveness of governments is only part of the equation. Evidence suggests that digital governance programmes may go unused when citizens lack trust in the government or when previous interactions with the government have left them disillusioned about their chances of being heard (Roberts and Hernandez, 2017). Merely providing information through digital technologies without the necessary power to effect change is unlikely to improve rural governance (Kosec and Wantchekon, 2020).

To leverage the potential of digital technologies for development outcomes in rural areas, it is crucial to organize and empower rural residents while implementing government reforms at local and national levels to ensure their voices are heard. Establishing an enabling environment for digital agriculture innovation is essential, and this requires building capacity within agriculture ministries and developing dedicated e-agriculture policies that are responsive to gender considerations (Trendov, Varas and Zeng, 2019a; Isenberg, 2019).

FAO, with its expertise in e-agriculture and gender mainstreaming, can play a vital role in supporting LICs and LMICs in developing their e-agriculture strategies and integrating gender-sensitive

BOX 8

Fostering the development of national digital agriculture strategies throughout Europe and Central Asia

FAO has been actively supporting countries in Europe and Central Asia in developing national digital agriculture strategies, road maps and programmes to promote the adoption of digital technologies. Here are some examples of FAO's support:

- Armenia: FAO assisted the Armenian Ministry of Economy in developing a draft national digital agriculture strategy for the period 2021–2030. The strategy aims to leverage digital technologies to improve market access, enhance food production and strengthen rural communities.
- Bosnia and Herzegovina: FAO played a role in collecting best practices and supporting the development of the country's first national strategy for digitalization in agriculture. The strategic frameworks developed at the state and entity levels recognize the importance of the agricultural sector for rural development, and FAO's assistance included a focus on encouraging rural women to embrace digital technology.
- Kazakhstan: FAO collaborated with the European Bank for Reconstruction and Development to implement the Inclusive Dairy Value Chain Development Project, which involved the digitalization of the milk supply chain. A mobile app called Collect Mobile was used to collect data on milk output, procurement and supply structure, improving supply chain management and supporting small-scale farmers in adhering to industry standards.
- Uzbekistan: FAO, along with its partners, is providing technical assistance to the Ministry of Agriculture in developing a programme of action for the digitalization of the agricultural sector. The programme will identify priorities and activities to accelerate digitalization and strengthen agricultural knowledge and innovation systems.

approaches (FAO, 2018b, 2015). The collaboration among international organizations, like the ITU and FAO, can continue to contribute to the development of digital agriculture ecosystems that empower rural populations and foster sustainable agricultural practices.

2.3.7 (Dys) functional local markets

The presence of market failures can significantly impact the success of digital agriculture solutions. A study by Aker, Ghosh and Burrell (2016) revealed that market failures contribute to the negative outcomes of digital agriculture projects aimed at improving farmers' access to information. While information can be valuable in improving smallholder incomes, it is not sufficient on its own to address the broader issues that limit farmers' ability to earn higher incomes. Making information actionable requires addressing the underlying market failures.

Various market failures have been identified as barriers to the success of digital agriculture projects. These include the lack of competitive markets, limited access to financial services such as credit, inadequate provision of public goods (e.g. infrastructure like roads), and the absence of secure property rights and contract enforcement. Additionally, the presence of monopsonies, where a single company dominates the purchasing of farmer crops,

hinders farmers' ability to negotiate prices and benefit from price information (Aker, Ghosh and Burrell, 2016).

Market failures are particularly prevalent in low-income settings, including poor rural areas. These areas experience multiple market failures, such as limited access to telecommunications and extension services due to high investment costs, challenges in securing credit due to lack of collateral, and difficulties in accessing crop insurance due to high claim settlement costs and monitoring requirements. Moreover, producers in these areas often face constraints in accessing markets for their crops (Cunningham, 2011; Mendoza and Thelen, 2008; Stiglitz, 1989).

Local agripreneurial digital and agritech start-ups can play a crucial role in providing context-specific digital solutions to smallholders and other rural actors involved in agrifood systems. However, they also face challenges arising from dysfunctional markets that lack professional services and finance opportunities, as well as a lack of guidance on scaling in underserved markets (Trendov, Varas and Zeng, 2019a). Therefore, it is essential for rural development organizations to thoroughly analyse offline markets and supply chains before implementing digital solutions. This analysis can help identify and address bottlenecks that may exist and require additional efforts before or during the implementation of digital solutions.

It is essential for rural development organizations to thoroughly analyse offline markets and supply chains before implementing digital solutions.

2.3.8 Representation

The underrepresentation of people living in rural areas, women and marginalized groups in technology companies, policymaking and decision-making fora, and ICT governing bodies has resulted in digital solutions and ICT policies that do not adequately address their needs (FAO, 2021). The lack of female ICT ministers and independent regulators headed by women further exacerbates the gender imbalance in shaping ICT policies (Isenberg, 2019). Interventions targeting rural areas in ICT for development rarely consider the priorities, needs and preferences of rural people themselves, leading to solutions that are dominated by urban male perspectives and less responsive to the needs of women (Isenberg, 2019).

The ICT sector itself is predominantly male- and urban-centric. Women are significantly underrepresented in the ICT workforce, particularly in roles that influence the creation and functioning of digital solutions. Globally, only 6 percent of digital application developers and 10 percent of internet entrepreneurs are female (Isenberg, 2019). The media narrative surrounding technology, rural development, agriculture and the economy is often controlled by men, resulting in a lack of visibility and recognition of the roles women play and their specific needs (Isenberg, 2019). There is a critical need to improve the representation of rural people,

especially rural women, and marginalized groups, in order to ensure that technologies, policies and initiatives better reflect their needs and priorities. Rural women should be viewed as active agents rather than passive recipients of aid and consumer products (Isenberg, 2019).

Addressing structural inequalities is essential for reducing unequal well-being outcomes from internet usage among marginalized groups. Merely providing access to technology and training is insufficient to bridge the digital divide. To reduce unequal outcomes, spatial inequalities for people in rural areas must be addressed across the SDGs. Good rural development is crucial for promoting digital inclusion and achieving more equitable digital and offline outcomes. Without improving the systems and structures within which rural people operate, they will remain disadvantaged with limited economic, social, political and personal resources that can be leveraged both online and offline, putting them at risk of further marginalization in the future.



Kenya

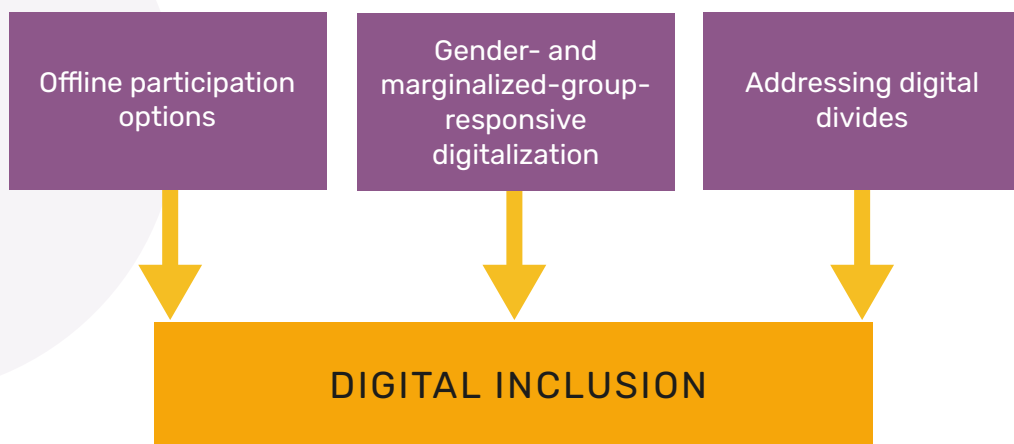
Two members of FAO Kenya using mobile phones to enter coordinates on eLocust3 application (OSRO/GLO/001/CHA).

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3 WAYS FORWARD: BEST PRACTICES TO IMPROVE DIGITAL INCLUSION

THE PREVIOUS SECTION DEMONSTRATED HOW DIGITAL DIVIDES AND DIGITAL INEQUALITIES contribute to people living in rural areas, women, and other marginalized groups in LICs and LMICs disproportionately being at risk of digital exclusion amidst digitalization and how structural and spatial inequalities lead to uneven outcomes even when they are digitally included. This section will highlight several ways that development actors can promote inclusion. These solutions are loosely grouped into three categories based on the framework presented in the introduction (see Figure 23 below): Gender and marginalized group-responsive digitalization, offline participation options and addressing digital divides.

FIGURE 23
Ways to improve digital inclusion



Source: Authors' own elaboration

FAO 1000 Digital Villages Initiative

In 2020, FAO launched the 1000 Digital Villages Initiative (DVI) to promote digital innovations to support inclusive, gender-sensitive rural development and sustainable agrifood transformation in alignment with Agenda 2030. DVI follows a country-led, user-centred, holistic digital ecosystem approach for digital village development. It combines a territorial approach with innovative design, pilot and deployment that combines end-user needs and demand, inclusive business models and local ownership to ensure

sustainability (FAO, 2022a). For example, in Latin America and the Caribbean, DVI is focusing on rural tourism experiences. It seeks to empower local communities by leveraging digital tools to improve their marketing strategies and enhance the sale of their tourism services, increasing their income and generating employment opportunities. The initiative has performed diagnoses in each country and offered a virtual course for producing marketing videos focused on young people (FAO, 2022b).

Sources: FAO. 2022a. *1,000 Digital Village Initiative: An initiative to expand digital innovations in rural villages for inclusive rural and agrifood systems transformation*. Bangkok, FAO Regional Office for Asia and the Pacific. <https://www.fao.org/3/cb9944en/cb9944en.pdf>

FAO. 2022b. *1000 Digital Villages Initiative presented its progress in 14 countries of Latin America and the Caribbean*. News Release. Santiago, FAO Regional Office for Latin America and the Caribbean.

In promoting the adaptation and transformation of digital technologies in rural areas, some international organizations such as FAO are carrying out innovative solutions of which the effective promotion of digital inclusion is an important aspect.

Actions addressing any of the three factors can help improve digital inclusion. However, combating all three factors at once is more likely to lead to an inclusive digital rural transformation.

Unlike digital exclusion which occurs due to a combination of three factors (digitalization that is not responsive to the needs of marginalized groups, removal of offline options, and digital divides), actions addressing any of the three factors can help improve digital inclusion. However, combating all three factors at once is more likely to lead to an inclusive digital rural transformation where digital solutions are tailored to the needs of all smallholders, who have the necessary level of digital connectivity to fully participate in society, and can choose to use offline alternatives according to their preferences, needs and priorities.

3.1 Gender- and marginalized-group-responsive digitalization

3.1.1 People-centred design

Development actors seeking to create digital solutions should adopt the digital development principles at a minimum. The digital development principles serve as best practice for the development of digital content, services and processes that seek to improve development outcomes. The first principle “design

with the user” stresses the element of co-creation: By designing with the users, and not for them, you can build digital tools to better address the specific context, culture, behaviours and expectations of the people who will directly interact with the technology. Designing together means partnering with users throughout the project lifecycle, co-creating solutions, and continuously gathering and incorporating users’ feedback (Principles for Digital Development, 2024).

Arathoon, Raithatha and Tricarico (2021) found that digital agriculture solutions that put their users at the centre during the pandemic were better placed to redesign their services to meet the needs of smallholder farmers. People-centred design requires that potential users be engaged in the process from the conceptualization phase through to implementation and evaluation. Unfortunately digital solutions that are relevant to people living in rural areas are not currently putting marginalized groups at the centre. Tsan *et al.*, (2019) found that digital agriculture apps that targeted women in their design, marketing and user engagement efforts boosted women’s uptake, but also found that most initiatives are not doing so.

Leaving no one behind will require putting not just any people at the centre. It will require putting the hardest-to-reach and most marginalized at the centre so that their unique needs are addressed either through the digital solution or through an alternative offline option. In this regard, FAO has consistently adhered to a people-centred approach to promote inclusivity. Building upon its existing work and network of partnerships, FAO is actively exploring and experimenting, yielding significant results at the project level.

3.1.2 Gender (and other marginalized group) responsiveness and mainstreaming

Solutions that treat all smallholders or rural people as a homogeneous group are likely to exclude rural women and other rural marginalized groups who are disproportionately affected by digital divides. Digital solutions can help overcome barriers experienced by women and other marginalized groups when designed and implemented in a gender-responsive way. The content and overall experience of digital agriculture apps need to be designed and/or adopted to meet the needs of women and other marginalized groups (FAO, 2018a).

Specifically, solution design should account for the technologies used by women and any after-access barriers experienced by women, men and other groups. For example, digital solutions need to account for cultural and social limitations, time and mobility constraints and lack of autonomy over use, literacy and education levels, among other factors that disproportionately affect women.

The inclusion of women and other marginalized groups in the design process and throughout the implementation of digital solutions can help identify and address their needs correctly. In some contexts, it can be useful to offer training and other interventions to men and

BOX 10

Gamification for digital learning: Preventing child labour and fostering safe work for youth in Lebanese agriculture

FAO developed a smartphone game called REEFI (meaning “my rural place” in Arabic) in collaboration with Plan International to improve the safety of child labourers in Lebanon, taking into account their digital skills, priorities and needs. One child shared, “After trying the game, I was in the field and I put on a jacket and a cap to protect myself from the sun, and I drank a lot of water. I did not feel any pain.” This is only one of the many testimonies that showcases the impact that the game has had on promoting occupational safety and health and addressing child labour in agriculture (FAO, 2022a).

The difference between what is an “acceptable task” and “child labour” is often determined by the dangerousness of the task. The game, REEFI, is FAO’s innovative tool (currently in its pilot phase) to learn through play for Lebanese and Syrian children and youth living in vulnerable conditions in rural areas.

It provides them with better access to education, training and safe working opportunities in rural areas through digital inclusivity.

Going beyond the direct benefit, trained children and youth can act as transformative agents, relaying simple messages of good and safe agricultural practices in their communities (FAO, 2022). After trying the game, a boy mentioned how he informed his siblings about protecting themselves and even encouraged them to play the game with him. As a result, his older brother wore a cap when going to work the following day. Furthermore, another child from the 16–18 age group stated, “Parents might realize the dangers that their children are exposed to after trying the game.” Launched in 2022 and available for Android and iOS platforms, REEFI was adapted and replicated in Mauritania in 2023.

Sources: FAO. 2022a. REEFI: game application on child labour and occupational safety and health in agriculture for rural children and youth [video]. [Cited 29 March 2024]. <https://www.youtube.com/watch?v=LD5egFLsAbM>

FAO. 2022b. FAO launches “REEFI”, a digital game on child labour and occupational safety and health in agriculture for rural children and youth. In: FAO – FAO in Lebanon. Rome. [Cited 29 March 2024]. <https://www.fao.org/lebanon/news/detail-events/ru/c/1480384/>

women separately, especially in situations where joint participation may limit women’s ability to speak freely (FAO, 2018a). Training must also take into account the daily timetables of women and other marginalized groups, and child care may need to be provided in some situations (FAO, 2018a).

However, initiatives should not focus exclusively on women. “It is far more effective to work with both women and men, and to explore the relationships and differences that exist among the two groups, in order to make a real impact and work towards changes in a community” (FAO, 2018a).

FAO (2018a) highlighted the need to mainstream gender across seven critical factors of success:

- Adapt content to the needs of both women and men.
- Consider the gender-sensitivity of capacity building across individual-, organizational- and enabling-environment levels.
- Consider the broader picture of gender relations in social dynamics.
- Ensure inclusive participation of women and men at all stages.
- Analyse and address gender issues among partners.

BOX 11

Talking Books provide an innovative solution to reach rural communities in Uganda

In some contexts, a lack of language and digital literacy can make delivering messages to beneficiaries over digital technology difficult for development actors. “Talking Books” were leveraged by FAO and Amplio (a United-States-based social enterprise) to provide training to people living in remote and underserved areas with low or no literacy who tend to be out of the reach of conventional development programmes. Around 400 Talking Book devices were provided to people in two districts in rural the West Nile region of Uganda. The audio devices are designed to operate in contexts where electricity and internet are limited. They function offline, use batteries and can play hours of audio content.

Each Talking Book is equipped with stories and

ideas regarding women’s rights and how they benefit entire households and communities. “The Talking Books motivate people to reflect on the gender dimension of land issues and discuss them, inducing through debates within households and whole communities,” said the Project Coordinator. Along with challenging social norms, the Talking Books also include content relevant to all farmers, including how to mitigate the impacts of climate change on food production and livelihoods.

FAO and Amplio had distributed Talking Books to the Farmer Field School networks and Watershed Management groups in Uganda, where listeners had the chance to record questions and feedback relating to the audio content. FAO and Amplio introduced and improved the audio messages based on this data.

- Use the right mix of technologies that meet the needs of women and men.
- Consider economic, social and environmental sustainability.

National agriculture, ICT and e-agriculture policies and strategies tend to neglect mainstreaming gender, leading to projects that are implemented in isolation and duplicate efforts and resources (FAO, 2018a). To overcome this challenge, FAO partnered with the ITU to develop an e-agriculture strategy guide that takes gender into account, which has already been piloted in several countries in the Asia-Pacific (FAO and ITU, 2016). It is necessary to continue to provide training and technical assistance to policymakers and digital service providers (as well as service providers seeking to digitalize their services) on mainstreaming gender and intersectionality across their work and activities. This can include technical assistance in ensuring the equal participation of women and men, improving gender awareness of staff, M&E systems that capture gendered differences, and mechanisms to address gender gaps when they occur (FAO, 2018a).

3.1.3 Making digital solutions accessible

Making websites and applications more accessible can help improve inclusion for groups with access to technology but experience additional barriers to getting online that accessibility features can accommodate. This includes persons with disabilities, people with low levels of literacy, and linguistic minorities, etc.

Providing content in multiple languages can help linguistic minorities access relevant content. The United Nations e-government survey

notes that over 80 percent of nation-states offer their national e-government portals in more than one official language (United Nations, 2022).

Responsive web design refers to a web development approach that allows for websites to automatically be scaled on screens based on the device being used, and should be adopted as best practice to provide positive user experiences for those who only have access to handheld devices (United Nations, 2022). “Currently many sites and tools are developed with accessibility barriers that make them difficult or impossible for some people to use” (W3C, 2024). The Web Content Accessibility Guidelines are an open international standard that helps make digital content more accessible to persons with disabilities, which should also be adopted.

3.2 Providing offline participation opportunities

3.2.1 Ensure offline service delivery options

Offline options are essential for reaching individuals who are less likely to be online (Hernandez and Roberts, 2018; United Nations, 2022). However, they are often briefly mentioned and lack concrete examples. For example, the most recent UN EGDI acknowledges that hybrid digital and offline solutions are necessary to promote inclusion, but the index also combines all efforts to promote inclusion into one single metric of inclusion, which itself includes a digital solution: “Free access to government online services is provided through kiosks, community centres, post offices, libraries, public spaces, or free Wi-Fi” (United Nations, 2022, p. 39). Further research is necessary to illustrate best practices in implementing parallel offline options for digital service delivery, which will provide insights into practical applications through case studies.

Digitalization can improve offline services through in-person service centres. Some governments have chosen to complement their one-stop shop national web portals and digital apps within person service centres where their residents can leverage the convenience of one-stop shops without having to use technology themselves. These centres consolidate government services and often provide additional assistance. Extensive government digitalization is needed to enable such centres, requiring data integration among service providers. For instance, the 24 Azerbaijan Service and Assessment Network (ASAN) service centres, in conjunction with its ASAN App and portal, offer citizens access to over 360 services from state and private entities (Karimil, 2022).

However, service centres are often few in number and tend to be concentrated in urban and densely populated areas. Some countries and subnational governments have taken innovative approaches to



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expand services offered in their one-stop-shop service centres to rural areas including through buses, trains and vans that periodically visit rural areas to provide in-person services (Jafarli, 2021; United Nations, 2022). In Azerbaijan, Citizens can check when the ASAN bus or train providing digital government services will visit their area online or through the phone. However, Azerbaijan only has ten ASAN buses and one ASAN train (Jafarli, 2021) and it is unclear how often they can cover each remote village. Thus, although such efforts improve inclusion to some extent, people living in rural areas are unable to benefit from being able to access them on a day of their choice the way urban residents can.

With the support of the United Nations Development Programme, the Government of Bangladesh has established 8 200 digital centres, offering 300-plus public and private services through the Aspire to Innovate programme (The Business Standard, 2021). The project aimed to create a digital centre in each of the 4 500-plus union councils, ensuring rural and less literate populations can access seamless digital services. These centres also provide additional digital services, such as agent banking from mobile money and traditional banks (Apolitical, 2022). Managed by local entrepreneurs, these centres function as start-ups, offering services at government-set low fees. They enable rural residents to access

digital government services conveniently, reducing the need to travel long distances to urban centres.

The Government of Malaysia introduced the Malaysia Government Call Centre (MyGCC) in 2012, a toll-free one-stop shop accessible 24/7 for residents to receive services from government agencies and ministries via phone (Malaysia.Gov.my, n.d.). MyGCC offers seven alternatives to the digital portal, including SMS, phone, email and social media platforms (Malaysia.Gov.my, n.d.). Multiple service delivery mechanisms, combining digital, face-to-face and offline options, have proven effective in enhancing inclusion. A study conducted by seven NGOs in SSA and South Asia demonstrated that a mix of digital and offline approaches maximizes inclusion, especially in low-literacy and high-poverty contexts (Feedback Mechanisms, 2016).

UNESCO and others found that using various remote learning methods during the pandemic benefited students from marginalized backgrounds (World Bank, UNESCO and UNICEF, 2021). Humanitarian initiatives leveraging digital tools recognize the need for in-person and mixed-methods approaches to address potential exclusions amplified by digital tools (Bryant, 2022). An FAO review emphasized the importance of providing multichannel alternative service delivery to ensure the inclusion of digital social protection systems (Barattini *et al.*, 2022). While concerns about an “over-the-counter trap” (Bakshi, 2014) in digital financial services have been raised, it is essential to view over-the-counter financial services as a tool to promote inclusion, particularly for less connected individuals.

Offline options, while beneficial in some respects, may offer a secondary service experience compared to online services. For instance, e-government benefit applications online are quick, with responses received within hours or less, whereas postal applications can take weeks. The earlier examples of ASAN buses and trains also underscore the limitations of inclusion efforts, which can result in temporary or infrequent access. Additionally, in-person service users may face long journeys to distant service points with limited operating hours, while digital service users enjoy the convenience of applying from home at any time. Furthermore, over-the-counter financial services are not universally available in rural areas. When designing offline alternatives, it is crucial to minimize factors that could lead to unequal user experiences.

3.2.2 Empowering digital intermediaries

As mentioned in Section 2, some people rely on others – known as proxies or intermediaries – to access all or some digital information or services (Selwyn *et al.*, 2016). Proxies can be friends, family members, people working at a community-based organization or NGO, or even strangers who charge for their services. For example, in rural Indian villages with low literacy rates among women, internet kiosks have employed and trained dedicated staff who could serve as proxy users for women who are unable to

make use of the kiosks on their own to access health information (Venkatesh, Sykes and Zhang, 2020). Grameen Foundation employs Community Knowledge Workers in rural Uganda who act as intermediaries between farmers and extension services mediated over a smartphone (FAO, 2018b). Evidence shows that female intermediaries are often more effective at reaching female farmers. Thus, it is important to train and include more females as intermediaries (FAO, 2018a). Info-ladies travel to remote villages in Bangladesh on bicycles equipped with laptops, USB sticks, and headphones to help thousands of people access the internet and tailor it to the needs of rural women.

Although many proxies already provided assistance to marginalized communities prior to the pandemic, the digitalization of essential services and the pausing or removal of in-person alternatives due to lockdowns and social distancing measures led many less connected individuals to reach out to CBOs and NGOs for help (Hernandez and Faith, 2020). Many turned to CBOs that do not typically address issues related to digital inclusion and thus many CBOs found themselves learning to provide such support on the go. Moreover, this often went largely unrecognized by service providers, and CBOs did not receive any additional financial support to help their communities access digital services. The result was that the cost of inclusion of less connected individuals was transferred to CBOs and other proxies. Identifying and supporting informal arrangements where intermediary CBOs in rural low- and middle-income settings will help less connected and less digitally savvy residents access digital services without formal support is vital.

3.3 Addressing digital divides

3.3.1 Provide telecentres with technical assistance related to inclusion

Telecentres refer to public places where people can go to access digital equipment and the internet and receive digital-skills training. They are one of the oldest measures seeking to improve digital access in rural areas, dating back to the 1990s. Telecentres have predominately been located in impoverished communities, specifically in rural areas, and are typically either funded by donors or run as microenterprises that charge users fees for their services and use of the internet (Toyama, 2011). Telecentres were touted as potential game changers and equalizers for rural people. Unfortunately, most telecentres have underperformed and struggled to remain financially viable, and many closed within months or years of opening. The few that succeed tend to be “run by devoted non-profit organizations that expend considerable effort and resources or by talented, dynamic entrepreneurs who manage multiple income-generating activities” (Toyama, 2011, p. 5).

Moreover, many telecentres have been shown to exclude marginalized and vulnerable groups. Telecentres that charge for fees automatically exclude potential users who are unable to pay. Moreover, social and gender norms can hinder marginalized groups (e.g. Indigenous groups) and women from making use of the telecentre, even in cases where they are accessible at no monetary cost (Toyama, 2011). In some places, “it might be [seen as] inappropriate for women to visit telecentres or cybercafés, or women might be reluctant to visit these because they do not feel at ease” or due to mobility constraints placed on women by cultural and social norms (FAO, 2018a, p. 27). As a result, better-off groups in rural areas – namely educated and employed young men – are often most likely to make use of telecentres.

Thus, expecting marginalized users to automatically access information via public computing (e.g. internet kiosks or telecentres) may be short-sighted since telecentres on their own reinforce inequalities within rural areas (Aker, Ghosh and Burrell, 2016; Toyama, 2011). Thus, the introduction of telecentres should be accompanied by efforts to both make them more accessible and responsive to the needs of marginalized groups, and to reform the cultural institutions that lead to marginalized groups to being seen as less worthy of making use of them. Locating telecentres near places where women already visit and travel to may help boost their attendance (FAO, 2018a). Governments and donors can play a role in making telecentres more available and their services more accessible. Such was the case in Bangladesh, where the government has helped set up over 8 200 digital centres, each offering local residents over 300 public and private services (The Business Standard, 2021).

3.3.2 Improve the focus of Universal Service Funds towards inclusion

Telecommunications companies tend to prioritize markets deemed as profitable. Unfortunately, rural and remote communities often have low purchasing power and dispersed populations which result in rural communities having less access to infrastructure, having their access updated later, and being more likely to be wholly disconnected from digital infrastructure altogether. Thus, markets alone are unable to deliver internet to all rural areas. Many countries have introduced Universal Service Funds (USFs) to fund infrastructure deployment in underserved areas. Along with deploying digital infrastructure, these funds are also often used to implement other digital-inclusion efforts in underserved areas like telecentres and digital-skills training programmes (Ogiemwonyi Arakpogun, Wanjiru and Whalley, 2017) governments across Africa have established USFs.

However, reviews have shown that most USFs are often poorly implemented, inefficient and ineffective. By 2013 more than half of the money raised by USFs were never used, and more than one-third of USFs were unable to implement any projects at all

BOX 12

Success story from Egypt on inclusive digital training

In January 2022, Ms Nevin Talaat, the manager of an agriculture extension centre in an Egyptian village in the Nile Delta, attended a five-day training course on digital skills delivered by FAO. Inspired by the knowledge she gained, she decided to introduce the same course to women at the village level. She formed a group of 15 women and 3 men who expressed interest in attending this course (FAO. n.d.a). She agreed with participants to hold the course sessions twice a week to accommodate other participant commitments, and she introduced the content at a relatively slow pace over two months to fit the characteristics of trainees. This included some basic digital skills on using common tools (e.g. email, WhatsApp, Microsoft Word), social media like YouTube and Facebook, Zoom and FAO Digital Services Portfolio (FAO, 2020).

The women were excited to attend the closing ceremony by the end of the course and receive training completion certificates. They enthusiastically shared their success stories, such as a woman who began to sell her poultry products through her children's Facebook pages. Another woman created a YouTube channel to showcase her poems, and a woman introduced her story of adopting meals from El Mufeed's healthy nutrition theme into her YouTube channel. Another woman applied the advisory guidelines of the household poultry production theme, resulting in improved health and production indicators, and a woman applied the food-safety guidelines at home that she learned from El Mufeed (FAO. n.d.b).

Sources: FAO. n.d.a. How FAO digital tools are helping Egyptian farmers to improve their livelihoods [video]. [Cited 3 April 2024]. https://www.youtube.com/watch?v=T43eTy_xZ84

FAO. n.d.b. The FAO digital app of "El-Mufeed in Food and Agriculture" [video]. [Cited 3 April 2024]. <https://www.youtube.com/watch?v=R8S1HIULV3o>

FAO. 2020. FAO & MALR invite extension agents to use "El Mufeed" app and disseminate among targeted groups. In: *FAO – FAO in Egypt*. Rome. [Cited 29 March 2024]. <https://www.fao.org/egypt/news/detail-events/en/c/1366074/>

(GSMA, 2016b, 2013; ITU, 2013). Ogiemwonyi Arakpogun, Wanjiru and Whalley (2017) found that African USFs often fail in part due to poor policy formulation, inadequate regulatory competence, narrow scope of USFs, inaccurate data, lack of accountability, inadequate stakeholder engagement and undue political influence. A study of USFs in Asia and the Pacific found "that countries with USFs targeting broadband/internet expansion have not experienced better results in fixed-broadband and internet growth than the countries without such fund" (UNESCAP, 2017).

Nonetheless, USFs has been shown to be an effective way to help improve infrastructure access and fund other inclusion efforts in places that have managed to overcome the barriers mentioned above. There are signs of LICs and MICs leveraging USFs to improve internet access, including in Pakistan and India (A4AI, 2020a, 2020b). Unfortunately, many USFs run on the assumption that all projects will benefit all rural residents equally. Efforts are needed to ensure that USFs are responsive to the needs of women and other marginalized groups living in rural areas in order to mitigate some of the risks uncovered by early investments in telecentres (World Wide Web Foundation, A4AI and UN Women, 2018).

Direct involvement in improving infrastructure is beyond the scope of many specialized UN agencies, like FAO. Still, it is crucial to advocate for and provide supporting efforts that make USFs investments – including budgets – responsive to the needs of people living in rural areas, women, youth and other marginalized groups.

BOX 13

FAO supported digital-skills development in Albania, Georgia and the Republic of Moldova

In Albania, three rural communities have benefited from enhancing their knowledge and utilization of e-agriculture, digital technologies and innovation: (i) Belsh, famous for its high-quality olive oil and vegetable production, (ii) Korçë, where apple and cherry production constitutes an important segment of the local economy and (iii) Malësi e Madhe, which specializes in cheese and dairy production. In accordance with national and local priorities and needs, digitalization was leveraged with the objective of increasing the competitiveness of the agritourism sector and income diversification. Together with the International Labour Organization, local farmers and extension services providers received training on how to promote and add value to local agricultural products, establish sustainable trading relationships and apply innovative digital solutions for precision agriculture and pest and soil management. In order to maximize scalability, training courses were made available in an online platform for a wider audience.

In 2022, FAO initiated a strategic collaboration with the Georgian Farmers' Association (GFA) to accelerate digital transformation of agriculture. Following an assessment of more than 300 farmers' needs and digital capacities, the GFA developed online tutorials to teach farmers how to promote their business digitally. In addition, good practices on the use of ICT were



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collected, featuring the stories of five farmers from Kvareli, Didi Lilo, Kvemo Kartli and Shida Kartli who improved production and increased sales thanks to precision agriculture technologies, farm management apps and social media promotion.

In the same year, FAO and the Federation of Agricultural Producers from the Republic of Moldova delivered training sessions to increase digital literacy among rural women in the districts of Cantemir, Hâncești and Râscani. The training covered a range of topics, including advanced technology solutions applicable in agriculture, online selling, digital payments, digital marketing and social media promotion.

3.3.3 Digital-skills training

The effort to provide digital-skills training to smallholders and rural communities needs to consider the multidimensional and evolving nature of digital skills. Given the evolving nature of digital technologies, digital training cannot be a one-off activity. Rural people may need periodic training support. Much training to date has focused on building computer-related skills (the skills in Table 6 in Section 2.2.5) and has been delivered in classrooms. Computer-based training is often delivered to prepare participants for the workforce and is often combined with more general job-readiness skills training (e.g. soft skills, business acumen, financial literacy, etc.) and tends to be concentrated in urban hubs (GSMA, 2021d). As Section 2.3.2 showed, these skills are in high demand by employers and computers still provide some advantages over smartphones for certain tasks and activities.

Thus, such training is necessary to improve employment prospects, especially for youth. However, it is also important to provide digital-

skills training that take into account people's priorities, motivations, and the devices people have access to. The majority of new users are accessing the internet via mobile phones, especially in rural areas in LICs and LMICs, making it also necessary to cover skills related to mobile and smartphone usage (GSMA, 2021d). Digital-skills training may need to be combined with basic literacy training in cases where illiteracy is high. GSMA (2021d, 2021e) recommends building trainee archetypes based on demographic groups to determine the needs and barriers for different segments of the population and target training accordingly.

Training is not automatically inclusive of women and marginalized groups. Additional efforts are needed to ensure that all groups are able to participate equally. In some contexts, it can be useful to offer training to men and women separately, especially in situations where joint participation may limit women's ability to speak freely (FAO, 2018a). Training should also take into account the differences in timetables, responsibilities and the social environments between men and women and different groups within rural areas. In some cases, it may be necessary to provide child care to incentivize the participation of women. Some initiatives have succeeded by leveraging the places and groups women already visit or engage with (FAO, 2018a).

Another option is training community members and encouraging them to share their access and knowledge with others (GSMA, 2021d). For example, Google and Tata Trusts have equipped rural women in India with phones, power bank and training, which they were encouraged to share. Along with providing digital-skills training directly to beneficiaries, specialized UN agencies like FAO can support the government and non-state actors in capacity building to deliver tailored digital-skills training.



The United Republic of Tanzania

A Sao Hill worker using a computer system controls the machines sorting and separating tree logs (GCP/INT/349/GER).

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4 CONCLUSIONS AND RECOMMENDATIONS

IN CONCLUSION, SMALLHOLDER FARMERS AND SMALL-SCALE PRODUCERS residing in rural areas are particularly vulnerable to digital exclusion. Rural poor, women, young people, persons with disabilities, Indigenous Peoples, older persons, migrants and displaced people are especially at risk of experiencing exclusion as a result of poorly managed digitalization. Digital exclusion results from three interrelated factors: (i) the digitalization of sectors crucial for the livelihoods and well-being of smallholders, (ii) the limited availability of offline alternatives, and (iii) the persistence of digital divides.

The first section of this report provided a glimpse of digitalization trends across several sectors vital to the well-being of smallholders and their families, including agrifood systems and beyond (education, government services and social protection). Unequal access to digital opportunities, services and content is negatively impacting access to essential services across all the sectors covered. Rural populations – particularly rural women and girls – face more significant barriers to digital engagement. Furthermore, as these sectors undergo digital transformation, it is also becoming increasingly challenging for rural communities to participate through offline means.

The second section of the report illustrated how people living in rural areas are disproportionately affected by digital divides. First, they have less access to digital technology and are more likely to encounter barriers. Second, they tend to have access to lower-quality digital connections, engage in fewer digital activities and encounter additional obstacles that impede their continuous and autonomous use of digital technology. Third, structural inequalities further influence their ability to equally benefit from digital technology use when compared with better-off groups.

Collaboration among various stakeholders is critical to addressing digital exclusion, digital inequalities and digital divide, achieving inclusive digitalization, and advancing rural transformation.

The third section summarized ways rural development actors can enhance digital inclusion for smallholders and rural populations more generally. Addressing digital exclusion requires concerted efforts across three areas: (i) bridging digital divides, (ii) promoting offline alternatives, and (iii) ensuring gender and marginalized-groups-responsive digitalization. Working across these three areas requires recognizing the specific needs and circumstances of smallholders and marginalized groups in rural areas and developing strategies that consider both online and offline approaches to assistance and service delivery. FAO and global development partners can leverage such an approach to help ensure that digitalization leaves no one behind and contributes to more efficient, inclusive, resilient and sustainable agrifood systems for better production, better nutrition, a better environment and a better life.

The rest of this conclusion summarizes recommendations based on the findings from the report.

4.1 Mapping the digital-inclusion landscape

Improving digital inclusion for rural communities requires a concerted effort across all sectors vital to their well-being (including agrifood systems and beyond) that are currently undergoing – or may soon undergo – digitalization. The first step for rural development partners and stakeholders should be to comprehensively assess the inclusivity of digitalization across these sectors in places where they are actively engaged. For each sector, the exercise should assess the level of participation of smallholders, the gender responsiveness of digital solutions, the required technologies and skills for engagement, and the availability of offline alternatives. A parallel assessment should examine access to technology, digital skills and access quality among rural populations to determine their level of readiness to engage digitally. Particular attention should be given to the readiness and needs of rural women and marginalized groups who are often most excluded from digital opportunities and services. By taking these actions, development partners and stakeholders can significantly enhance the evidence-base for their collective efforts to advance digital inclusion.

Rural communities will continue to require access to offline alternatives given their disproportionate likelihood of experiencing of digital divides and lower levels of digital access. For this reason, mapping exercises must identify areas where offline alternatives are absent or have been removed or reduced. Collaborating with relevant stakeholders is essential to introduce or reintroduce offline alternatives, particularly in areas where their absence adversely affects smallholder farmers and small-scale producers.

FAO and partners should also seek to establish collaborative frameworks to ensure comprehensive representation of rural areas

in existing mappings, such as UNDESA's e-government index. This is particularly relevant considering the index's recent expansion to include data related to large cities while the e-government experiences of rural communities remain poorly understood.

4.2 Develop a normative framework, guidelines and surveys on digital inclusion

Digitalization is not inherently inclusive of rural communities and marginalized groups. It is thus imperative to guide science and innovation towards more equal outcomes through normative frameworks and policy guidance.

It is necessary for rural development organizations to adopt digital-inclusion narratives based on the three factors that improve digital inclusion identified in this report: (i) marginalized-group- and gender-responsive digitalization, (ii) ensuring offline alternatives, and (iii) tackling digital divides across all levels. This narrative can assist rural development organizations and practitioners in adapting organizational practices and implementing programmes



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that address digital exclusion and avoid exacerbating inequalities. Once an internal normative framework is in place, a digital-inclusion guideline can be developed to help partner rural development organizations improve digital inclusion. Such a tool can help rural development organizations and digital agriculture practitioners integrate inclusive practices into programme/project design and field operations.

There is a lack of data that comprehensively considers the multidimensional nature of the digital divide, including after-access barriers such as: slow internet speeds, insufficient data, intermittent access, lack of digital skills, reliance on others for connectivity, and the use of subpar devices. Digital-inclusion surveys based on the new conceptualization can help better inform policymakers, UN agencies and partner programming regarding beneficiary needs and their digital realities. Efforts should be made to disaggregate survey data by gender and other groups at risk of digital exclusion (e.g. Indigenous groups, racial and ethnic minorities, migrants, and persons with disabilities) in order to capture diverse experiences within countries. Further disaggregation of surveys using UN geospatial frameworks that categorize rural areas based on agricultural potential, access to markets, population density and development domains can help account for heterogeneity between rural areas. Data collected and analysed through surveys can be assessed against an index similar to A4AI's Meaningful Connectivity Index which compiles minimum connectivity thresholds (4G speeds, smartphone or PC access, unlimited data and daily use). Such composite indicators could help improve comparison across time and contexts in ways that better capture the multidimensional nature of the digital divide and risks of digital exclusion.

Importantly, these initiatives should not be limited to the development of technical papers or data collection, but should also aim to raise awareness and enhance digital literacy and capabilities. It is recommended that concerned entities provide digital-inclusion and digital-divide training to their staff and other rural development stakeholders through their respective e-learning platforms, focusing on understanding the potential benefits and risks associated with technology and innovation for individuals living in poverty or vulnerable situations.

Beyond these above-proposed actions, providing technical assistance to national and regional institutes to strengthen their capacity to generate and collect data related to digital inclusion is crucial, as well as providing technical support to other rural development actors, private sector entities and government agencies on implementing digital solutions that effectively address digital exclusion and divides. In this regard, exploring opportunities to leverage the International Platform for Digital Food and Agriculture can be a means for FAO to promote a deeper understanding of digital inclusion among various stakeholders engaged in digital agriculture, by sharing case studies and best practices on addressing digital exclusion to help promote knowledge exchange and the replication of successful approaches.

4.3 Adopt a gender- and marginalized-group-responsive approach

The digitalization of sectors vital to the well-being of rural communities is currently being carried out in ways that are not adequately responsive to the needs of all people living in rural areas, especially women and marginalized groups. The responsiveness of digital solutions and digitalization efforts could be improved through the adoption of a human-rights approach and the digital development principles, which both emphasize the importance of people-centred design. Ensuring the meaningful and effective participation of intended users from marginalized backgrounds (for example rural women, young people, Indigenous Peoples, racial and ethnic minorities, migrants, and persons with disabilities) throughout the entire digital solution lifecycle (ideation, design, pilot testing, implementation, and evaluation) can significantly help improve the chances that digital solutions will fit their realities and meet their needs.

Adopting a holistic approach and employing multifaceted strategies is crucial to fostering digital inclusion. For example, FAO's experience has found that local assessments to identify the various barriers and exclusionary factors that hinder specific groups and individuals from reaping the benefits of digital technology adaptation are necessary. These factors may include limited financial resources, discrimination, illiteracy or digital isolation. Thus, allocating appropriate budgets and designing programmes responsive to the needs of marginalized groups in rural areas – and promoting gender responsiveness – are essential to direct resources where they are most needed.

In addition, making apps and digital content available in languages spoken by the target users and in formats that are accessible and user-friendly can help break down language and accessibility barriers that hinder access.

4.4 Ensure offline participation opportunities for rural populations

The overarching SDG objective calls for development actors to “reach the furthest behind first.” In the context of digital rural transformations, this means prioritizing the needs of groups least able to make use of digital technology.

It is important to acknowledge that rural women and marginalized segments of the rural population will continue to be less able to engage digitally in the short- and medium-term. Thus, additional



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offline options will often be the only way to ensure that they are able to fully participate in society and that digitalization does not result in their exclusion. Multichannel service delivery that mixes digital (e.g. apps, SMS, websites, chatbots, call-centres, etc.) and offline service delivery mechanisms (e.g. service centres, kiosks, postal services, etc.) should be promoted as best practice. Multichannel approaches foster inclusion by providing people with choice the most suitable means of engagement, and including options for those who may prefer to engage offline.

Offline service delivery does not necessarily contradict digital transformations. In fact, digital transformation can help improve the efficiency and cost effectiveness of offline alternatives given that digital technology can serve as the infrastructure that connects the back-end of all service delivery channels, thus creating a service delivery landscape that is larger than the sum of its parts.

The digital landscape maps proposed in section 4.1 can play a crucial role in identifying sectors where offline options have been reduced or eliminated. These maps can uncover sectors that are contributing to the exclusion of offline and less connected populations, allowing for targeted actions and strategic resource allocation. The maps can also inform advocacy for the (re)introduction of offline mechanisms in sectors and areas where they are currently absent.

Collaboration with various stakeholders is essential given the cross-sectoral nature of this trend. Technical support should be extended to government agencies, civil society organizations, private sector entities, and other development actors to encourage the integration of offline alternatives into their digital solutions from the very beginning.

Additionally, continuing support for digital intermediaries who facilitate access to digital technology for rural populations should be taken into consideration. This may include providing financial contributions or in-kind support in the form of equipment, internet access and training to digital intermediaries to empower them to serve their communities more effectively.

4.5 Promote access to digital technology and address after-access barriers

Unfortunately, it may not be possible to fully ensure that all actors in every sector relevant to the well-being of rural communities digitalize their services and operations in ways that are inclusive. Thus, efforts will also be needed to bridge the digital divides to help rural communities access content, services and opportunities from providers and sectors outside the influence of FAO and partners.

It is crucial for UN agencies like FAO to effectively collaborate with relevant stakeholders to tackle access barriers, including the affordability of data and devices, access to electricity and identification requirements, by improving the inclusivity of digital infrastructure deployment through the provision of technical assistance on gender-responsive budgeting and programming to USFs. Such guidance can help ensure that the specific needs and priorities of rural women and other marginalized rural groups are adequately considered when USFs are used to deploy infrastructure or implement digital-inclusion projects.

Addressing after-access barriers is necessary to ensure effective digital technology use in rural areas. The lack of digital skills among smallholder farmers and rural communities is a major after-access barrier that must be addressed through large-scale training programmes. Digital-skills training should be made available to rural people of all ages. Primary and secondary schools should incorporate it in their curriculum. Additional efforts will be needed to provide widespread digital-skills training for people of working age and out of school. Given the pace of technological change, training programmes will need to be periodically updated to keep pace. Providing dynamic digital-skills training at scale will require significant capacity building and collaboration efforts. FAO can foster sustainable, locally-led efforts to enhance digital literacy by building the capacity of governments and non-state actors to provide digital training. Digital-skills trainings will need to be

designed in ways that take the specific needs of rural women, older people and other marginalized groups into account. For example, digital-skills training may need to be tailored to the schedules of rural women and other marginalized groups. Separate digital training for women and other marginalized groups may improve access to training and learning outcomes in situations where social norms or discrimination hinder their full participation.

When providing devices to smallholders and other beneficiaries, it is important to ensure that the devices provided are sufficiently secure. One factor to consider when providing smartphones is whether the model will continue to receive security patches and software updates for the duration of its intended use, or longer if possible.

It is essential to consider how issues of autonomy may affect usage of digital technologies and digital solutions. This is especially true for users who mainly access digital technologies through borrowed devices or who have their access mediated by others. These issues have been shown to affect women more than men and can have implications for the types of digital activities users can engage in and tasks that users can perform.

It is important that all organizations working on digital inclusion in rural areas are aware of these after-access barriers and consider them in their programming to mitigate their impact on smallholders and rural communities.

4.6 Reducing the structural inequalities that lead to digital divides

In an increasingly digital world, it is more important than ever to tackle poverty and structural inequalities alongside digital divides. FAO and partners must double down efforts to address disparities between urban and rural areas, between men and women, as well as between marginalized and better-off groups within rural areas. Effectively reducing structural inequalities and poverty levels requires persistent efforts over time rather than quick fixes. Strong collaboration between stakeholders from all sectors affecting the lives of rural communities is needed to overcome the deep-rooted issues that plague rural development.

Levels of education are strongly correlated with digital technology adoption, digital-skills acquisition and the ability to benefit from the use of technology. Initiatives strengthening access to education and improving educational outcomes for smallholder farmers and rural populations should continue to be prioritized, especially for women and marginalized groups. This includes support for lifelong learning

opportunities which can help foster continuous skill development and knowledge acquisition for smallholders and rural communities.

Social and gender norms are often more entrenched and restrictive in rural LMIC contexts. Efforts to address social norms that may hinder rural women from accessing, owning and using digital technology autonomously should be strengthened. Interventions at the family and community levels are essential to ensure the long-term sustainability of such efforts.

People living in rural areas, women and marginalized groups are less represented in technology companies, policymaking and decision-making fora, and in national and international ICT governing bodies. This results in digital solutions and ICT policies that do not adequately consider or meet their needs. Efforts are needed to increase the participation of rural communities and rural women in the design of digital solutions, policies and investments that impact their well-being. At a more transformative level, it is important to increase their representation in technology sector roles and policymaking positions with power.

As a result of spatial inequalities, local and grassroots organizations from rural areas have less capacity to make use of digital technologies to advance their causes. UN agencies and global development organizations should strengthen their support for rural organizations to help ensure that they are able to engage digitally. Support could be made available in the form of funding or through in-kind digital equipment and digital-skills training. Rural organizations that may require such support include producer organizations, specialized cooperatives, rural advisory groups, local for-profit enterprises, NGOs, farmer and business associations, CBOs, local government agencies and paragonovernmental entities.

Informal institutions will also need to be strengthened or reformed to improve digital outcomes for smallholders and rural communities. The prevalence of market failures in many rural areas can limit the success and utility of digital agriculture solutions and digital marketplaces. Addressing market failures is an intractable complex problem that requires collaboration with governments, rural development actors, the private sector and smallholders.

Last but not least, LICs and LMICs should be supported in developing their digital agriculture strategies. Current joint initiatives between UN specialized organizations such as the partnership between FAO and ITU in the result of e-Agriculture Strategy and National Strategy Guide, should be leveraged for this cause. An effective digital agriculture strategy should prioritize digital inclusion and meeting the needs of rural populations, particularly women and marginalized groups.



Somalia

GPS tracking devices in preparation for aerial spraying to fight against locust swarms (UTF/SOM/062/SOM).

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